Final
Environmental Assessment

Falcon 9 and Falcon 9 Heavy
Launch Vehicle Programs
from Space Launch Complex 4 East

Vandenberg Air Force Base
California

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FINDING OF NO SIGNIFICANT IMPACT

Falcon 9 and Falcon 9 Heavy Launch Vehicle Programs from Space Launch Complex 4 East at Vandenberg Air Force Base, California

Pursuant to provisions of the National Environmental Policy Act (NEPA), 42 U.S. Code 4321 et seq., implementing Council on Environmental Quality (CEQ) regulations, 40 Code of Federal Regulations (CFR) 1500-1508, and 32 CFR Part 989, *Environmental Impact Analysis Process*, the United States (U.S.) Air Force and Space Exploration Technologies (SpaceX) conducted an assessment of the potential environmental consequences associated with the operation of the Falcon 9 and Falcon 9 Heavy launch vehicle programs from Space Launch Complex 4 East (SLC-4E) on Vandenberg Air Force Base (VAFB or Base), California.

The Environmental Assessment (EA), incorporated by reference to this finding, considers all potential environmental impacts of the Proposed Action and the No-Action Alternative. The EA also considers these impacts cumulatively, in conjunction with other agency projects near and at VAFB. The EA analyzes the potential environmental consequences of activities associated with the proposed modifications to SLC-4E to accommodate the Falcon 9 and Falcon 9 Heavy launch vehicle programs, and their operation from SLC-4E, and provides guidelines to avoid adverse environmental effects.

PROPOSED ACTION

SpaceX proposes to operate its Falcon 9 and Falcon 9 Heavy launch vehicle programs to provide commercial and government space operations from SLC-4E at VAFB. SLC-4E is located on south VAFB, was previously used for the Titan IV program, and has been non-operational since 2005. The Falcon launch vehicle program, including the Falcon 9 and Falcon 9 Heavy launch vehicles, is designed for minimal vehicle assembly and processing on the launch pad. The goal is to launch within a few days to several weeks of payload arrival at the launch site. The Falcon 9 is a medium-lift launch vehicle, weighing approximately 693,000 pounds with an overall length of 178 feet. The Falcon 9 Heavy is a heavy-lift launch vehicle with a gross lift-off weight of 1,950,000 pounds and overall length of 180 feet. Both vehicles use liquid oxygen and highly refined kerosene as propellants to carry payloads into orbit. Some modifications and new construction would be required at SLC-4E to accommodate the Falcon 9 and Falcon 9 Heavy launch vehicles. Modifications needed include the demolition of some existing facilities, an action previously assessed under the *Final Programmatic Environmental Assessment for the Demolition and Abandonment of Atlas and Titan Facilities, Vandenberg Air Force Base, California* (VAFB 2005); improvements to the administrative building; installation of propellant tanks; re-installation (or re-initiation) of utilities; resurfacing of the launch water deluge drainage and retention basin, resurfacing of the entrance road, and refurbishment of the security system, if required. SpaceX plans to utilize existing facilities, structures, and utility connections where possible. However, a new Integration and Processing Hangar would be constructed within the current perimeter of SLC-4E, requiring approximately 30,000 square feet of space, plus 7,500 square feet of paved area for vehicle maneuvering, and a 20 feet wide by 250 feet long access road by the side of the Hangar. Modifications and new construction would start in 2011 and is anticipated to last approximately 24 months, with up to 100 local and 100 transient workers required to complete this aspect of the project.
During the operational phase, SpaceX anticipates a maximum of 10 launches per year, one-half being Falcon 9 and one-half being Falcon 9 Heavy launches. Launch campaigns on a per-mission basis are expected to last from 2 to 8 weeks. During this period of time, up to 100 local and 100 transient employees would be present at SLC-4E. Between launch campaigns, 30 to 50 employees would be present at the site.

NO-ACTION ALTERNATIVE

Under the No-Action Alternative, the Falcon 9 and Falcon 9 Heavy launch vehicle programs would

not operate from SLC-4E and no modifications would be made at this site. SLC-4E would remain nonoperational.

While this alternative would result in no effect to the existing environment, it would also not meet the Commercial Space Launch Act goal to encourage the use of underutilized government infrastructure and resources to promote commercial investment and use of space, nor the National Space Policy commercial space guideline for the United States Government to make available infrastructure for commercial use on a reimbursable, noninterference, and equitable basis to the maximum practical extent. The No-Action Alternative would also restrict U.S. options for space launch into polar and sunsynchronous orbits, which are typically used for imaging, earth observation, and weather satellites.

SUMMARY OF FINDINGS

The analyses of the affected environment and environmental consequences of implementing the Proposed Action, as presented in the EA, concluded that with implementation of the environmental protection and monitoring measures described in Chapter 4, no significant impact or adverse effects should result to Cultural Resources (Section 4.3), Hazardous Materials and Waste Management (Section 4.4), Human Health and Safety (Section 4.5), Orbital Debris (Section 4.6), Socioeconomics (Section 4.7), Solid Waste Management (Section 4.8), Transportation (Section 4.9), and Water Resources (Section 4.10). In addition, the EA concluded that the Proposed Action would not affect Environmental Justice. On November 16, 2010, the California Coastal Commission concurred with the negative determination under the Coastal Zone Management Act submitted by the Air Force for the Proposed Action. Likewise, on November 16, 2010, the California State Historic Preservation Officer concurred with the finding of No Adverse Effect for the Proposed Action in compliance with Section 106 of the National Historic Preservation Act. No cumulative significant or adverse impacts should result from activities associated with the modifications to SLC-4E and operation of the Falcon 9 and Falcon 9 Heavy launch vehicle programs, when considered in conjunction with past, present, or reasonably foreseeable future agency projects near and on VAFB (Section 4.11).

Two areas of environmental consequences, Air Quality and Biological Resources, evaluated in the EA were determined to have the potential to result in less than significant impacts to the environment.

Air Quality

During modifications to SLC-4E, fugitive dust emissions generated from equipment operating on exposed ground and combustive emissions from the equipment would cause adverse air quality impacts. During operation of the Falcon 9 and Falcon 9 Heavy launch programs, emissions from employee vehicles, emergency generators and from the launch vehicles, would also cause adverse air quality impacts. None of the anticipated impacts would be significant (see EA Sections 3.1 and 4.1). Emissions from the Proposed Action would not exceed significance thresholds; therefore, no adverse impacts to the region's air quality would occur. All measures described in the EA would be implemented to further decrease emissions during project activities.

Biological Resources

The Proposed Action has the potential to result in short-term temporary adverse effects to biological resources within the overpressure zone, overflight zone, and in areas within 7.4 miles of SLC-4E, which may experience noise levels up to 100 A-weighted decibels (dBA) during launches. Adverse effects would be limited to disturbance with no physical impacts to existing habitats or vegetation expected. Long-term, permanent effects are anticipated within the SLC-4E complex and within 30 feet of the exterior fence line due SLC-4E modifications and the resumption of landscape maintenance practices. Compliance with the Migratory Bird Treaty Act would be accomplished through pre-construction surveys and protection of active nests as described in Section 4.2 of the EA. The U.S.

Fish and Wildlife Service (USFWS) issued two Biological Opinions (December 10, 2010, updated June 24, 2011) that concluded that the Proposed Action may affect, but is not likely to adversely affect, the federally threatened western snowy plover, California red-legged frog, and southern sea otter and the federally endangered California least tern. The USFWS also determined that the Proposed Action is not likely to jeopardize the continued existence of the endangered El Segundo blue butterfly and issued an Incidental Take Statement for that species. SpaceX shall fund, implement, and comply with all protective measures and terms and conditions included in the Biological Opinions to compensate for any adverse effects on federally-listed species.

California least terns (*Sterna antillarum browni*) nest in open dune habitat at Purisima Point, which is outside the overpressure, overflight, and 100 dBA noise zones, and are known to forage at the Santa Ynez River estuary, which although outside the overpressure and overflight zones, is within the 100 dBA noise zone. To date no launches originating from South Base, including SLC-4E, have occurred during their nesting season for which a monitoring requirement has been in place. It is unknown how nesting terns would respond to a launch from SLC-4E. Given the distance to the nesting area it is unlikely that launch related noise would alter their behavior. However, the Santa Ynez River estuary area may receive a significant amount of noise that could briefly affect foraging behavior. Monitoring of terns at the Purisima Point breeding site and the Santa Ynez River estuary during the first launch of a Falcon 9 and a Falcon 9 Heavy space vehicle that occurs when terns are present on VAFB would be completed to determine if adverse effects associated with launch noise occur.

A total of 139 seacliff buckwheat (*Eriogonum parvifolium*) plants (host plant to the federally endangered El Segundo blue butterfly [*Euphilotes battoides allyni*]) were identified within the SLC-4E complex. Although these plants cannot be fully excluded as potential habitat for the butterflies, the small amount of habitat, the extensive distribution of seacliff buckwheat on VAFB, and the fact that El Segundo blue butterflies have not been documented within the overpressure zone, indicate the loss of habitat within the site is unlikely to adversely affect VAFB populations of the butterfly. A flight season survey would be conducted within the project area to determine if the butterfly is present. Seacliff buckwheat plants will be flagged and avoided, including a 2-foot buffer around each plant, so long as doing so does not preclude program operations need. Any buckwheat plants lost due to construction would be replaced at a pre-designated restoration site at a 1:5 ratio. A biological monitor would be onsite to help ensure the adverse effects to the seacliff buckwheat plants are minimized. If more than 0.4 acre of seacliff buckwheat plants are damaged or destroyed within SLC-4E due to the Proposed Action, operations causing such take must cease, and Section 7 consultation under the Endangered Species Act must be reinitiated.

Under the Marine Mammal Protection Act of 1972, the National Oceanic and Atmospheric Administration National Marine Fisheries Service (NOAA Fisheries) issued the 30th Space Wing at VAFB a 5-Year Permit for unintentional take of small numbers of marine mammals incidental to space vehicle launches (74 FR 6236), and a 1-year Letter of Authorization (LOA) on January 25, 2010, authorizing the take of small numbers of marine mammals incidental to space vehicle launches. The LOA includes activities conducted pursuant to the SpaceX Falcon program. The LOA establishes required monitoring of select pinniped species on VAFB and the Northern Channel Islands to document their behavioral response and other potential adverse effects as a result of launch noise and sonic booms. SpaceX shall fund, implement, and comply with all monitoring requirements established in the LOA.

FINDING OF NO SIGNIFICANT IMPACT

Based upon my review of the facts and analyses contained in the attached EA, conducted in accordance with the provisions of NEPA, the CEQ regulations, and 32 CFR Part 989, I conclude that the Proposed Action would not have a significant environmental impact, either by itself or cumulatively with other projects at VAFB or within the region of influence. Accordingly, an Environmental Impact

Statement is not required. The signing of this Finding of No Significant Impact completes the environmental impact analysis process.

FINDING OF NO SIGNIFICANT IMPACT
CONCURRENCE PAGE
In Conjunction with Final Environmental Assessment for the Falcon 9 and Falcon 9 Heavy Launch Vehicle Programs from Space Launch Complex 4 East at Vandenberg Air Force Base, California
MAJCOM Approval:

11 JUL 11

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SES, DAF
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and Mission Support

Final
Environmental Assessment

Falcon 9 and Falcon 9 Heavy
Launch Vehicle Programs
from Space Launch Complex 4 East

Vandenberg Air Force Base
California

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1 March 2011

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Acronyms and Abbreviations

%	Percent
ºF	Degrees Fahrenheit
µg/m^3	Micrograms per cubic meter
2 ROPS	2nd Range Operations Squadron
30 CES	30th Civil Engineer Squadron
30 CES/CEA	30th Civil Engineer Squadron, Asset Management Flight
30 CES/CEANC	30th Civil Engineer Squadron, Asset Management Flight, Environmental Conservation
30 CES/CEANP	30th Civil Engineer Squadron, Asset Management Flight, Pollution Prevention and Sustainment
30 CES/CEANQ	30th Civil Engineer Squadron, Asset Management Flight, Environmental Quality
30 CES/CEANR	30th Civil Engineer Squadron, Asset Management Flight, Environmental Restoration
30 CES/CEF	30th Civil Engineer Squadron, Fire Department
30 MDG	30th Medical Group
30 SW	30th Space Wing
30 SW/SE	30th Space Wing, Safety Office
30 SW/SEL	30th Space Wing, Launch Safety Office
ADT	Average daily traffic
AFI	Air Force Instruction
AFMAN	Air Force Manual
AFOSH	Air Force Occupational Safety and Health
AFSPC	Air Force Space Command
AFSPCMAN	Air Force Space Command Manual
Air Force	United States Air Force
AOC	Area of Concern
AOI	Area of Interest
API	American Petroleum Institute
ASME	American Society of Mechanical Engineers
AST	Aboveground storage tanks
Base	Vandenberg Air Force Base
BCC	Federal bird of conservation concern
BGEPA	Bald and Golden Eagle Protection Act
BMP	Best management practice
B.P.	Before present
C&D	Construction and demolition
CAA	Clean Air Act
CAAA	Clean Air Act Amendments
CAAQS	California Ambient Air Quality Standards
Caltrans	California Department of Transportation
CAP	Consolidated collection accumulation point
CARB	California Air Resources Board
CCA	California Coastal Act
CCAFS	Cape Canaveral Air Force Station
CCR	California Code of Regulations
CCS	Central coast scrub
CDFG	California Department of Fish and Game

CEQ	Council on Environmental Quality
CEQA	California Environmental Quality Act
CFR	Code of Federal Regulations
CH_4	Methane
CHP	California Highway Patrol
CIWMB	California Integrated Waste Management Board
CLTE	California least terns
cm	Centimeter
CO	Carbon monoxide
CO_2	Carbon dioxide
CO_2e	Carbon dioxide equivalent
CRLF	California red-legged frog
CSML	City of Santa Maria Landfill
CSOSA	Commercial Space Operations Support Agreement
CWA	Clean Water Act
CZMA	Coastal Zone Management Act
dB	Decibel
dBA	A-weighted decibel
DOD	Department of Defense
DOT	Department of Transportation
EA	Environmental assessment
EO	Executive Order
EOD	Explosive ordnance disposal
EPA	Environmental Protection Agency
EPP	Environmental Protection Plan
ESA	Endangered Species Act
ESBB	El Segundo blue butterfly
FAA	Federal Aviation Association
FE	Federal endangered species
FP	California fully protected species
FR	Federal Register
ft	Feet
ft^2	Square feet
FT	Federal threatened species
GHG	Greenhouse gases
GIS	Geographic information system
GPS	Global Positioning System
GTO	Geostationary Transfer Orbit
GWP	Global warming potential
H_2S	Hydrogen sulfide
Hangar	Integration and Processing Hangar
HAP	Hazardous air pollutant
HazMart	Hazardous Materials Pharmacy
HAZWOPER	Hazardous Waste Operations and Emergency Response
HFC	Hydrofluorocarbon
Hp	Horsepower
HPP	Historic Preservation Plan
HQ AFSPC/SG	Headquarters Air Force Space Command, Surgeon General
HVAC	Heating, ventilation, and air conditioning
Hwy	Highway
ID	Identification

IPA	Isopropyl alcohol
IRP	Installation Restoration Program
ISB	*In-situ* Bioremediation
ITE	Institute of Transportation Engineers
kgs	Kilograms
Klbf	Kilopounds force
KN	Kilonewtons
kVA	Kilovolt amperes
lbs	Pounds
LEA	Local enforcement agency
LEO	Low Earth Orbit
L_{eq1H}	One-hour average sound level
LH_2	Liquid hydrogen
LIDAR	Light detection and ranging
LOA	Letter of Authorization
LOS	Level of Service
LOX	Liquid oxygen
MACT	Maximum Achievable Control Technology
m	Meter
m^3	Cubic meter
mg/m^3	Milligrams per cubic meter
Mlbs	Million pounds
MMH	Monomethylhydrazine
MMPA	Marine Mammal Protection Act
mph	Miles per hour
MSRS	ManTech SRS Technologies, Inc.
N_2O	Nitrous oxide
N/A	Not applicable
NAAQS	National Ambient Air Quality Standards
NASA	National Aeronautics and Space Administration
NCA	Noise Control Act
NCI	Northern Channel Islands
NEPA	National Environmental Policy Act
NESHAP	National Emissions for Hazardous Air Pollutants
NFPA	National Fire Protection Association
NHPA	National Historic Preservation Act
NNG	Non-native grassland
NNW	Non-native woodland
NO_2	Nitrogen dioxide
NO_x	Nitrogen oxides
NOAA Fisheries Service	National Oceanic and Atmospheric Administration National Marine Fisheries Service
NOI	Notice of Intent
NOT	Notice of Termination
NPDES	National Pollutant Discharge Elimination System
NRHP	National Register of Historic Places
NSR	New source review
NTO	Nitrogen tetroxide
O_3	Ozone
O&M	Operations and maintenance
OASPL	Overall sound pressure levels

OEEL	Occupational and Environmental Exposure Limit
OSHA	Occupational Safety and Health Administration
Oz	Ounces
P2	Pollution prevention
Pb	Lead
PFC	Perfluorocarbon
PFDP	Preliminary Flight Data Package
$PM_{2.5}$	Particulate matter 2.5 microns or less in diameter
PM_{10}	Particulate matter 10 microns or less in diameter
POL	Petroleum, oil, and lubricant
PPA	Pollution Prevention Act
ppm	Parts per million
psf	Pounds per square foot
RCRA	Resource Conservation and Recovery Act
RIP	Arroyo willow riparian forest
ROG	Reactive organic gas
ROI	Region of influence
RP-1	Rocket propellant-1 or refined petroleum-1
RWQCB	Regional Water Quality Control Board
SAP	Satellite accumulation point
SBCAPCD	Santa Barbara County Air Pollution Control District
SCAQMD	South Coast Air Quality Management District
SCCAB	South Central Coast Air Basin
SCI	Santa Cruz Island
SE	California Endangered Species
SF_6	Sulfur hexafluoride
SHPO	State Historic Preservation Officer
SIP	State implementation plan
SLC	Space launch complex
SMI	San Miguel Island
SO_x	Sulfur oxides
SO_2	Sulfur dioxide
SO_4	Sulfates
SpaceX	Space Exploration Technologies, Inc.
SR	State Route
SRI	Santa Rosa Island
SRM	Solid rocket motor
SRS	SRS Technologies, Inc.
SSC	California species of special concern
STD	Standard
STS	Space Transportation System
SWFL	Southwestern Willow Flycatcher
SWFP	Solid waste facility permit
SWI	Space Wing Instruction
SWP	Space Wing Plan
SWPPP	Storm Water Pollution Prevention Plan
SWRCB	State Water Resources Control Board
THC	toxic hazard corridor
TNT	Trinitrotoluene
UCSB	University of California Santa Barbara
UDMH	Unsymmetrical dimethyl hydrazine

UFC	Unified Facilities Criteria
U.S.	United States
USACE	United States Army Corps of Engineers
USACERL	United States Army Construction Engineering Research Laboratory
USAF	United States Air Force
U.S.C.	United States Code
USFWS	United States Fish and Wildlife Service
USGS	United States Geological Survey
UST	Underground storage tank
UXO	Unexploded ordnance
V/C	Volume to roadway capacity
VAFB	Vandenberg Air Force Base
VIP	Very important person
VOC	Volatile organic compound
WRCC	Western Regional Climatic Center
WSPL	Western snowy plover
yd^3	Cubic yard

Chapter 1. Purpose of and Need for the Proposed Action

Space Exploration Technologies, Inc. (SpaceX) proposes to operate the Falcon 9 and Falcon 9 Heavy launch vehicle programs from Space Launch Complex (SLC)-4E on Vandenberg Air Force Base (VAFB or Base), California. In order to accommodate the Falcon 9 program operational requirements, modifications and new construction would be required at SLC-4E.

This Environmental Assessment (EA) evaluates the potential environmental consequences of operating the Falcon 9 and Falcon 9 Heavy launch vehicle programs from SLC-4E. This EA also evaluates the potential environmental consequences of the required modifications and new construction at SLC-4E. The National Environmental Policy Act (NEPA) and the Council on Environmental Quality (CEQ) regulations require lead agencies to evaluate potential impacts of federal actions on the human environment. As the United States (U.S.) Air Force (Air Force or USAF) would license the required land and facilities to SpaceX, the Air Force is the lead federal agency for NEPA compliance on the proposed project. This (EA) has been prepared in accordance with the NEPA of 1969, as amended (42 U.S.C. 4321 et seq.); as implemented by CEQ regulations (40 Code of Federal Regulations [CFR] Parts 1500-1508); and 32 CFR Part 989.

To ensure that launch services provided by private enterprises are consistent with national security and foreign policy interests of the U.S. and do not jeopardize public safety and the safety of property, the Commercial Space Launch Act of 1984 (Public Law 98-575), as codified at 49 U.S. Code (U.S.C.) 70101-70119, authorizes the Department of Transportation (DOT) to license and regulate U.S. commercial launch activities. Within the DOT, the Secretary of Transportation's authority under the Commercial Space Launch Act has been delegated to the Federal Aviation Administration (FAA) Office of Commercial Space Transportation. Therefore, the FAA is a cooperating agency in reviewing the preparation of this EA. Because the National Aeronautics and Space Administration (NASA) contributed to the Falcon launch vehicle development through their Commercial Orbital Transportation Services program, and could be a user of the vehicle from this launch site, they are also a cooperating agency.

SpaceX intends to launch both government and commercial missions from VAFB. When required, SpaceX would apply for a launch license from the FAA to conduct commercial space launches. Also when required, SpaceX would apply for a re-entry license from the FAA for the re-entry of commercial payloads, including re-entry of the SpaceX capsule called the Dragon.

At the conclusion of the FAA's environmental review process, the FAA will issue its own environmental finding document to support its licensing determinations. In addition to the environmental review, applicants for a launch or reentry operator license must work with the FAA to complete pre-application consultation, a policy review and approval, safety review and approval, payload review and determination, and a financial responsibility determination.

1.1 Project Location

VAFB is headquarters for the 30th Space Wing (30 SW). The Air Force's primary missions at VAFB are to launch and track satellites in space, to test and evaluate America's intercontinental ballistic missile systems, and support aircraft operations in

the Western Range. As a non-military facet of operations, VAFB is also committed to promoting commercial space launch ventures.

VAFB is located on the south-central coast of California, approximately halfway between San Diego and San Francisco (Figure 1-1). The Base covers approximately 99,000 acres in western Santa Barbara County (VAFB 2007a), and occurs in a transitional ecological region that includes the northern and southern distributional limits for many plant and animal species.

The Santa Ynez River and State Highway 246 divide VAFB into two distinct parts – North Base and South Base. SLC-4E, which SpaceX proposes to modify and from which to operate the Falcon 9 and Falcon 9 Heavy programs, is located on South Base. It is approximately 4.0 miles south of the Santa Ynez River and 0.9 mile east of the Pacific Ocean. Figure 1-2 illustrates the regional location of the project area.

1.2 Background

The Commercial Space Launch Act of 1984 (Public Law 98-575), as codified at 49 U.S.C. 70101-70119, declares that the development of commercial launch vehicles and associated services is in the national economic interest of the U.S. The Commercial Space Launch Act also allows government infrastructure and resources currently underutilized to be used as excess capacity to promote commercial investment and use of space. The Air Force provides support to the U.S. Government and commercial entities for low-cost and reliable access to space.

The U.S. has recognized that space transportation costs must be significantly reduced to make continued exploration, development, and use of space more affordable. The National Space Policy of 28 June 2010 (U.S. Government 2010) includes as one of its principles a commitment to "encouraging and facilitating the growth of a U.S. commercial space sector that supports U.S. needs, is globally competitive, and advances U.S. leadership in the generation of new markets and innovation-driven entrepreneurship". The National Space Policy provides these guidelines (in part):

- Encourage an innovative and entrepreneurial commercial space sector.
- Enhance operational efficiency, increase capacity, and reduce launch costs by investing in the modernization of space launch infrastructure.
- Purchase and use commercial space capabilities and services to the maximum practical extent when such capabilities and services are available in the marketplace and meet U.S. Government requirements.
- Ensure that U.S. Government space technology and infrastructure are made available for commercial use on a reimbursable, noninterference, and equitable basis to the maximum practical extent.

1.3 Purpose of and Need for the Proposed Action

The purpose of the Proposed Action is to substantially reduce the cost of reliable U.S. enterprise access to space, thus complying with the National Space Policy. The purpose of the Proposed Action also is to protect the public health and safety, safety of property, and national security and foreign policy interests of the U.S. during commercial launch or reentry activities. The action would encourage, facilitate, and promote commercial space launches and reentries by the private sector, and would facilitate the strengthening and expansion of the U.S. space transportation infrastructure, in accordance with the requirements of the Commercial Space Launch Act of 1984.

SpaceX's Falcon launch vehicle program, under which the Falcon 9 and Falcon 9 Heavy vehicles are included, is part of a commercial venture to provide high reliability with a relatively low cost. The Falcon 9 and Falcon 9 Heavy programs are designed to

Figure 1-1. Regional location of VAFB.

Figure 1-2. Proposed project area at SLC-4E, and the local vicinity.

require reduced time for vehicle assembly and final payload processing at the launch site. The goal of the Falcon launch vehicle program is to launch a vehicle within a few days to several weeks of payload arrival at the launch site; therefore, payload processing and launch pad use times would be reduced (Aerostar 2006).

The Falcon 9 and Falcon 9 Heavy vehicles are two-stage medium- to heavy-lift vehicles used to place large to very large payloads in orbit (17,850 and 24,000 pounds [lbs] respectively for the Falcon 9 and Falcon 9 Heavy). Very large payloads could include those used for government missions or to establish orbital infrastructure.

The VAFB launch location is proposed as it supports launches to polar and sun-synchronous inclinations, which are useful for a number of commercial and government satellite missions, including weather and reconnaissance missions. SLC-4E is proposed in particular due to its current availability, its history of substantial previous use as a launch site, and the support facilities present there. Falcon program operations from SLC-4E would start in 2012.

The Proposed Action, and other similar endeavors, is needed to fulfill the National Space Policy commercial space guideline for the United States Government to make available infrastructure for commercial use on a reimbursable, noninterference, and equitable basis to the maximum practical extent. Based on the need to reduce space transportation costs while providing high reliability and safety, SpaceX, a privately held company, used solely private funding to build launch vehicles and a cargo/crew capsule.

1.4 Criteria for Site Selection

SpaceX established the following criteria for selecting a location for operation of the Falcon 9 and Falcon 9 Heavy launch vehicle program:

- Ability to launch space vehicles capable of placing payloads into polar and sun-synchronous inclinations.
- Accessibility for delivery of space vehicle components and payloads safely, reliably, and cost effectively.
- Reduced risk to systems reliability as a result of harsh environment.
- Ability to support anticipated annual launch rates (10 per year).
- Reduced cost - Established launch complex with minimal costs for refurbishment and existing infrastructure.
- Reduced effects to natural environment – Developed launch complex requiring minimal construction that could affect natural environment.
- Reduced conflicts with existing space missions.

1.5 Scope of the Environmental Assessment

Consistent with Title 32 CFR Part 989, and CEQ regulations (40 CFR 1500-1508), the scope of analysis presented in this EA is defined by the potential range of environmental impacts resulting from implementing the Proposed Action and alternatives. Pursuant to 40 CFR Part 1501.4(c), resources potentially impacted are considered in more detail to provide sufficient evidence and analysis to determine whether or not to prepare an environmental impact statement. This EA identifies, describes, and evaluates the potential environmental impacts that could result from the Proposed Action and No-Action Alternative. No other reasonable alternatives were identified that met the requirements for the Falcon 9 and Falcon 9 Heavy programs. VAFB is the only space launch facility that provides the required parameters for launching proposed payloads for the Falcon 9 vehicles and placing them into polar and sun-synchronous inclinations. SLC-4E is an

existing launch complex that would require minimal modifications to accommodate the Falcon 9 and Falcon 9 Heavy programs, thus minimizing adverse environmental effects.

This EA also considers and evaluates possible cumulative impacts from other past, present, and reasonably foreseeable future actions. In addition, this EA identifies environmental permits relevant to the Proposed Action. As appropriate, it describes in terms of a regional overview or a site-specific description, the affected environment and environmental consequences of the Proposed Action, and identifies measures to prevent or minimize environmental impacts.

Resources analyzed in this EA include air quality; biological resources; cultural resources; hazardous materials and hazardous waste management; human health and safety; orbital debris; socioeconomics; solid waste management; transportation; and water resources. The following resources were considered but not analyzed in this EA:

- ***Earth Resources.*** All construction under the Proposed Action would occur within the SLC-4 fence line. This area has been extensively developed in the past and no adverse effects on geology or soils are anticipated. Only minimal digging is anticipated to provide a level route from the proposed Integration and Processing Hangar (or Hangar) to the launch pad. If the Hangar is located at the preferred southerly location (as discussed further in Section 2.1.2.3), based on removing a 24-foot (ft) wide roadway, approximately 932 ft in length, earth removal is estimated to be approximately 4,370 cubic yards (yd^3). An additional 222 yd^3 of excavation would be required for an access road located to the side of the Hangar. If the Hangar is located at the alternate northern location, the roadway would be approximately 24-ft wide, 1,234 ft in length, and approximately 4,962 yd^3 of earth would be removed, with the additional 222 yd^3 of excavation for the access road located to the side of the Hangar. For either Hangar location, excavation would not exceed a maximum depth of 16 ft. All soil excavated during construction activities would be used as backfill, and any excess materials would be spread throughout the site.

  Project construction would comply with seismic design standards as specified in Air Force Space Command Manual (AFSPCMAN) 91-710, *Range Safety Requirements*.

  The Proposed Action would have no bearing on liquefaction. Thus, potential hazards due to liquefaction are not anticipated.

- ***Environmental Justice.*** Per Executive Order (EO) 12898, *Environmental Justice*, the potential effects of the Proposed Action on minority communities and low-income communities were considered. Because the Proposed Action and any potential effects would occur within VAFB boundaries, it would not affect low income or minority populations within the region (Lompoc and Santa Maria Valleys).

- ***Land Use and Aesthetics.*** The Proposed Action would not change land use or affect land use planning at VAFB. Additionally, there would be no conversion of prime agricultural land to other uses, and no decrease in its productivity. Finally, the Proposed Action would not conflict with VAFB environmental plans or goals, Air Force regulations, permit requirements, or existing uses of the proposed project area or other facilities nearby.

  While land use would not be affected, one aspect of land use, the management of the coastal zone, merits further discussion. Federal activity in or affecting a coastal zone requires preparation of a Coastal Zone Consistency Determination or a Negative Determination, in accordance with the federal Coastal Zone Management Act (CZMA) of 1972. The California Coastal Zone Management Program was formed through the California Coastal Act (CCA) of 1972. The Air Force is responsible for submitting consistency and negative determinations to the California Coastal Commission for Air Force activities within the coastal zone. The California Coastal Commission reviews

federally authorized projects for consistency with the California Coastal Zone Management Program, and either concurs or does not concur with the Air Force's determination.

On VAFB, the coastal zone extends inland from approximately 0.75 mile at the northern boundary to 4.5 miles at the southern end of the Base. The CZMA and CCA mandate that the scenic and visual qualities of coastal areas be considered and protected as a resource of public importance. SLC-4E, located off of Kelp Road (Figure 1-2), is within the California Coastal Zone and the proposed activities are subject to consistency with the CZMA. The demolition of the mobile service tower and several other smaller structures at SLC-4E was previously assessed (VAFB 2005), and is not covered under this EA. Based on the build up and facilities already present at the site, the proposed construction of the Integration and Processing Hangar (250 ft long by 120 ft wide by 75 ft tall) is not anticipated to adversely impact the scenic and visual qualities of this coastal area. Access to the coast at Wall and Surf Beaches would be restricted during launches. At program maturity, up to 10 launches per year may occur, with coastal access restricted for a short period of time (6 to 8 hours). No adverse effects to the coastal zone, as defined by the CZMA and CCA, are anticipated. SpaceX coordinated with the Air Force and the California Coastal Commission and requested concurrence with a Negative Determination. On 16 November 2010, the California Coastal Commission concurred with the Negative Determination (California Coastal Commission 2010).

1.6 Applicable Regulatory Requirements

Federal and state regulations applicable to the Proposed Action and the No-Action Alternative are summarized in Table 1-1.

Table 1-1. Federal and state regulations applicable to the Proposed Action and No-Action Alternative.

Federal Regulation	Activity or Requirement
American Indian Religious Freedom Act of 1978 (42 U.S.C 1996)	The American Indian Religious Freedom Act states that the policies and procedures of federal agencies must comply with the constitutional clause prohibiting abridgment of religious freedom—including freedom of belief, expression, and exercise—for Native Americans. The American Indian Religious Freedom Act policy is to consider Native American access to sites, use and possession of sacred objects, and freedom to worship, and directs federal agencies to revise policies and procedures to correct conflicts with Native American religious cultural rights and practices.
Archaeological and Historic Preservation Act of 1974 (16 U.S.C. 469a et seq.)	The Archaeological and Historic Preservation Act is directed toward the preservation of historic and archaeological data that would otherwise be lost as a result of federal construction or other federally licensed or assisted activities. The Archaeological and Historic Preservation Act authorizes the Department of the Interior to undertake recovery, protection, and preservation of archaeological or historic data.
Archaeological Resources Protection Act of 1979 (16 U.S.C. 470aa-mm), Supplemental Regulations of 1984	The Archaeological Resources Protection Act secures protection of archaeological resources and sites on public and Indian lands; requires permitting for any excavation or collection of archaeological material from these lands; and provides civil and criminal penalties for violations.
Clean Air Act of 1970 (42 U.S.C. 7401 et seq.)	The Clean Air Act states that applicable national ambient air quality standards must be maintained during the operation of any emission source. National Ambient Air Quality Standards include primary and secondary standards for various pollutants. The primary standards are mandated by the Clean Air Act to protect public health, while the secondary standards are intended to protect the public welfare from adverse impacts of pollution, such as visibility impairment.
Clean Air Act Amendments of 1990	These amendments establish new federal non-attainment classifications, new emissions control requirements, and new compliance dates for areas in non-attainment. The requirements and compliance dates are based on the non-attainment classification.

Federal Regulation	Activity or Requirement
Clean Water Act of 1977 as amended (33 U.S.C. 1251 et seq.)	Prohibits the discharge of pollutants from a point source into navigable Waters of the US, except in compliance with a National Pollutant Discharge Elimination System (40 CFR Part 122) permit. Navigable Waters of the US are considered to encompass any body of water whose use, degradation, or destruction will affect interstate or foreign commerce. Section 404 of the Clean Water Act establishes a program to regulate the discharge of dredged and fill material into waters of the U.S., including wetlands. Activities in waters of the US that are regulated under this program include fills for development, water resource projects (such as dams and levees), infrastructure development (such as highways and airports), and conversion of wetlands to uplands for farming and forestry. Section 401 of the Clean Water Act requires that the discharge of dredged or fill material into water of the U.S. does not violate state water quality standards. Generally, no Clean Water Act Sec. 404 permits will be issued until the State has been notified and the applicant has obtained a certification of state water quality standards.
Coastal Zone Management Act of 1972 (16 U.S.C. 2452-24645).	The Coastal Zone Management Act plays a significant role in water quality management. Under the Act, a federal action that may affect the coastal zone must be carried out in a manner that is consistent with state coastal zone management programs.
Endangered Species Act of 1973 (7 U.S.C. 136; 16 U.S.C. 460 et seq.)	Declares the intention of Congress to conserve threatened and endangered species and the ecosystems on which these species depend. The Endangered Species Act requires that federal agencies, in consultation with the U.S. Fish and Wildlife Service and the National Oceanic and Atmospheric Administration National Marine Fisheries Service, use their authorities in furtherance of its purposes by carrying out programs for the conservation of endangered or threatened species.
Energy Independence and Security Act of 2007 (P.L. 110-140, H.R. 6)	Section 438 of the Energy Independence and Security Act of 2007 requires any development or redevelopment project involving a federal facility with a footprint that exceeds 5,000 square feet shall use site planning, design, construction, and maintenance strategies for the property to maintain or restore, to the maximum extent technically feasible, the predevelopment hydrology of the property with regard to the temperature, rate, volume, and duration of flow.
Energy Policy Act of 1992 as amended (42 U.S.C. 8256 et seq.)	The Energy Policy Act requires that federal agencies significantly reduce their use of energy and reduce environmental impacts by promoting the use of energy-efficient and renewable energy technologies.
Migratory Bird Treaty Act of 1918 as amended (16 U.S.C. 703-712)	The Migratory Bird Treaty Act implements various treaties and conventions between the United States and Canada, Japan, Mexico, and the former Soviet Union for the protection of migratory birds. Under the Act, taking, killing or possessing migratory birds is unlawful.
National Environmental Policy Act of 1969 as amended (42 U.S.C. 4321-4347)	Requires federal agencies to analyze the potential environmental impacts of major federal actions and alternatives and to use these analyses as a decision-making tool on whether and how to proceed.
National Historic Preservation Act of 1966 as amended (16 U.S.C. 470 et seq.)	The National Historic Preservation Act is the key federal law establishing the foundation and framework for historic preservation in the U.S. The Act authorizes the Secretary of the Interior to expand and maintain a National Register of Historic Places, establishes an Advisory Council on Historic Preservation as an independent federal entity; requires federal agencies to take into account the effects of their undertakings on historic properties, and to afford the Council an opportunity to comment upon any undertaking that may affect properties listed, or eligible for listing, in the Register; and makes the heads of all federal agencies responsible for the preservation of historic properties owned or controlled by them.
Native American Graves Protection and Repatriation Act of 1990 (25 U.S.C. 3001-3013)	The Native American Graves Protection and Repatriation Act restores certain rights to Native Americans with respect to the disposition of ancestral human remains and cultural objects; vests ownership of these materials (from federal or tribal lands) with designated Native American groups; requires notification of federal agency head when Native American cultural items are discovered on federal or tribal lands; prohibits trafficking in Native American human remains and cultural items; requires inventory and tribal notification of human remains and associated funerary objects held in existing collections by museums or federal agencies; and provides for repatriation of these materials.

Federal Regulation	Activity or Requirement
Noise Control Act of 1972 (42 U.S.C. 4901 et seq.)	The Noise Control Act establishes a national policy to promote an environment for all Americans free from noise that jeopardizes their health and welfare. To accomplish this, the Act establishes a means for the coordination of federal research and activities in noise control, authorizes the establishment of federal noise emissions standards for products distributed in commerce, and provides information to the public respecting the noise emission and noise reduction characteristics of such products. The Act authorizes and directs that federal agencies, to the fullest extent consistent with their authority under federal laws administered by them, carry out the programs within their control in such a manner as to further the policy declared in 42 U.S.C. 4901. Each department, agency, or instrumentality of the executive, legislative and judicial branches of the federal government having jurisdiction over any property or facility or engaged in any activity resulting, or which may result in, the emission of noise shall comply with federal, state, interstate, and local requirements respecting control and abatement of environmental noise.
Occupational Safety and Health Act of 1970 (29 U.S.C. 659-678)	The Occupational Safety and Health Act was established to assure safe and healthful working conditions for working men and women by: authorizing enforcement of the standards developed under the Act; by assisting and encouraging the states in their efforts to assure safe and healthful working conditions; by providing for research, information, education, and training in the field of occupational safety and health; and for other purposes.
Pollution Prevention Act of 1990	The Pollution Prevention Act establishes that pollution should be prevented or reduced at the source whenever feasible; pollution that cannot be prevented should be recycled in an environmentally safe manner, whenever feasible; pollution that cannot be prevented or recycled should be treated in an environmentally safe manner whenever feasible; and that disposal or other release into the environment should be employed only as a last resort and should be conducted in an environmentally safe manner.
Resource Conservation and Recovery Act of 1976 (42 U.S.C. 6901 et seq.)	The Resource Conservation and Recovery Act gives the U.S. Environmental Protection Agency the authority to control hazardous waste from the "cradle-to-grave." This includes the generation, transportation, treatment, storage, and disposal of hazardous waste. The Act also sets forth a framework for the management of non-hazardous wastes.
State Regulation	**Activity or Requirement**
California Coastal Act of 1976	The California Coastal Act provides long-term protection of California's 1,100-mile coastline for the benefit of current and future generations. Coastal Act policies constitute the standards used by the Coastal Commission in its coastal development permit decisions and for the review of local coastal programs prepared by local governments and submitted to the Commission for approval. These policies are also used by the Commission to review federal activities that affect the coastal zone.
Clean Air Act of 1988	The Clean Air Act develops and implements a program to attain the California Ambient Air Quality Standards for ozone, carbon monoxide, nitrogen dioxide, sulfur dioxide, particulate matter less than or equal to 10 microns in diameter, lead, sulfates, hydrogen sulfide, and vinyl chloride. 40 CFR Part 51 gives state and local agencies the authority to establish air quality rules and regulations. Rules adopted by the local air pollution control districts and accepted by the Air Resources Board are included in the State Implementation Plan. When approved by the U.S. Environmental Protection Agency, these rules become federally enforceable.
Porter-Cologne Water Quality Control Act	Protects all waters of the state for the use and enjoyment of the people of California and declares that the protection of water resources be administered by the regional water quality control boards.
California Integrated Waste Management Act of 1989, California Assembly Bill AB 939	Provides for the proper management and disposal of solid wastes, to include the diversion requirements for construction and demolition debris.
California Global Warming Solutions Act of 2006	Requires that by 2020 the State's greenhouse gas emissions be reduced to 1990 levels, a roughly 25% reduction under business as usual estimates. The California Air Resources Board, under the California Environmental Protection Agency, is to prepare plans to achieve the objectives stated in the Act. As defined in the bill, “greenhouse gases” include all of the following gases: carbon dioxide, methane, nitrous oxide, hydrofluorocarbons, perfluorocarbons, and sulfur hexafluoride. These are the same gases listed as Greenhouse Gases in the Kyoto Protocol.

1.7 Permits, Licenses, and Other Entitlements

The following permits, licenses and other entitlements associated with environmental resources were identified during development of this EA, and must be finalized for implementation of the Proposed Action. This list is not all inclusive and additional permits, licenses, and entitlements may be required, including DOT and FAA permits and licenses.

- Negative Determination under the Coastal Zone Management Act - California Coastal Commission
- Biological Opinion under Section 7 of the Endangered Species Act - U.S. Fish and Wildlife Service
- Concurrence with a No Adverse Effect Determination under Section 106 of the National Historic Preservation Act – California State Historic Preservation Officer
- U.S. Environmental Protection Agency (EPA) Identification (ID) Number or a California ID Number (depending on the amounts and types of hazardous waste produced) – U.S. EPA
- Environmental Protection Plan - VAFB
- Hazardous Waste Management Plan in accordance with the VAFB Hazardous Waste Management Plan - VAFB
- Spill Prevention and Response Plan (prior to construction activities) – VAFB
- Emergency Response Plan in accordance with the VAFB Hazardous Materials Emergency Response Plan - VAFB
- Health and Safety Plan – VAFB
- Notice of Intent, Notice of Termination, Stormwater Pollution Prevention Plan, and Risk Assessment (permit registration documents for NPDES General Permit for Construction Activities) – VAFB
- Hazardous Materials Contingency Plan - VAFB
- Spill Prevention Control and Countermeasures Plan for aboveground propellant storage tanks - State Water Resources Control Board (SWRCB)
- Registration of aboveground storage tanks - SWRCB
- Authority to Construct (permit) - Santa Barbara County Air Pollution Control District (SBCAPCD)
- Permit to Operate for stationary sources (i.e., generators) - SBCAPCD
- Stormwater Pollution Prevention Plan - Central Coast Regional Water Quality Control Board
- California Business Plan or Disclaimer for propellant storage - Santa Barbara County Fire Department

Chapter 2. Description of the Proposed Action and Alternatives

This chapter describes the Proposed Action, the No-Action Alternative, and other identified alternatives. The chapter provides detailed descriptions of the operational parameters for the Falcon 9 and Falcon 9 Heavy launch vehicle programs from SLC-4E. It also describes the planned modifications to SLC-4E, construction requirements, and anticipated equipment needs.

2.1 Proposed Action

Under the Proposed Action, SpaceX proposes to operate its Falcon 9 and Falcon 9 Heavy launch vehicle programs to provide commercial and government space operations from SLC-4E at VAFB. It also proposes to make modifications to SLC-4E for program operations.

2.1.1 Program Operation

The Falcon launch vehicle program, including all its models, is designed for minimal vehicle assembly and processing on the launch pad. The goal is to launch within a few days to several weeks of payload arrival at a launch site. The Falcon 9 and Falcon 9 Heavy launch vehicles are described below, as are the operational parameters for these programs.

2.1.1.1 Falcon 9

The Falcon 9 (Figure 2-1) is a medium-lift class launch vehicle with a gross lift-off weight of approximately 693,000 lbs with an overall length of 178 ft. The Falcon 9 uses liquid oxygen (LOX) and highly refined kerosene, also known as rocket propellant-1 or refined petroleum-1 (RP-1), as propellants to carry payloads into orbit.

First and Second Stages

The first stage of the Falcon 9 is approximately 12 ft by 100 ft, and includes nine Merlin 1C engines. The Merlin engine is a 90,000 lb thrust LOX/RP-1 engine with a pump-fed gas generator cycle, turbine exhaust roll control, and hydraulic thrust vector control. The first stage consists of aluminum LOX and RP-1 tanks that hold approximately 38,700 gallons of LOX and 24,900 gallons of RP-1.

The second stage is approximately 12 ft by 41 ft, not including the fairing and payload, and uses one Merlin Vacuum engine. The fairing would be 17 ft by 35 ft, and a smaller version may also be used. The second stage consists of approximately 7,300 gallons of LOX and 4,600 gallons of RP-1 in tanks with a common bulk head.

The Falcon 9 launch vehicle uses helium gas stored in high pressure composite over wrapped cylinders to pressurize the propellant tanks. Quantities of helium required for Falcon 9 processing are 130 lbs for first stage pressurization with engine spin start and purging, and 54 lbs for second stage pressurization. The helium flow is controlled through solenoid valves. The first stage includes a 10 watt transmitter and the second stage includes a 20 watt transmitter.

Flight Termination System

The launch vehicle would be equipped with both a thrust termination and a destructive flight termination system in the event it varied from the planned trajectory. The thrust termination system is activated by a command from the appointed officer from the 30 SW Safety office (30 SW/SE) and disables power to the vehicle engines. Once power is removed, there are up to six different valves

Figure 2-1. The Falcon 9 launch vehicle.

that close and immediately shut off the first stage engines. Four valves close on the second stage, again shutting down the stage's engines. Thus, upon activation of the thrust termination system, the Falcon 9 launch vehicle would fall intact and may explode upon impact, depending on the circumstances and time in the flight when the termination is activated. The flight termination system also includes linear shaped charges that are intended to rupture the vehicle tanks when commanded to destruct, thus dispersing propellants. In this event, the debris would impact a wider area but in smaller pieces. The termination method selected by 30 SW/SE officer would be based on the vehicle's trajectory and its payload.

2.1.1.2 Falcon 9 Heavy

The Falcon 9 Heavy (Figure 2-2) is a heavy-lift class launch vehicle with a gross lift-off weight of approximately 1,950,000 lbs. It could place satellites/payloads into Low Earth Orbit (LEO), and Geostationary Transfer Orbit (GTO). It has a width of 12 ft and an overall length of 180 ft.

First and Second Stages

The Falcon 9 Heavy consists of a standard Falcon 9 with two additional boosters supporting the first stage flight. The booster pods are slightly modified versions of the Falcon 9 first stage. Thus, each is 12 ft by 100 ft and has nine Merlin 1C engines.

Figure 2-2. Notational depiction of the Falcon 9 Heavy launch vehicle.

Like the Falcon 9 vehicle, the Falcon 9 Heavy uses LOX and RP-1 for its propellants. Thrust on lift-off is approximately 3,375 kilopounds force (Klbf; 15,000 kilonewtons [KN]).

The Falcon 9 Heavy second stage would be identical to the Falcon 9 second stage. It is 12 ft by 41 ft, and again uses LOX and RP-1 propellants. The fairing for the Falcon 9 Heavy would be larger to accommodate larger payloads – it may be up to 50 ft in length. Like the Falcon 9 the first stage includes a 10 watt transmitter and the second stage includes a 20 watt transmitter.

Flight Termination System

The Falcon 9 Heavy flight termination system would be identical to the Falcon 9, except that each booster would also include ordnance required to destruct the booster in the event of inadvertent separation.

Table 2-1 provides the general characteristics of the Falcon 9 and Falcon 9 Heavy vehicles, along with other space launch vehicles

2.1.1.3 Launch Trajectories

The Falcon 9 and Falcon 9 Heavy launch trajectories would be specific to each particular mission, but would fall within lower and upper limit azimuths (153 degrees to 301 degrees), as defined for the Western Range in Volume 1 (1 July 2004) of the AFSPCMAN 91-710, *Range Safety Requirements*. Approved launch azimuths would be based on launch risk analysis for specific launch vehicle performance characteristics. Example trajectories from SLC-4E would primarily be high and low azimuth trajectories for sun-synchronous and polar orbits.

2.1.1.4 Payloads

All Falcon 9 and Falcon 9 Heavy flights would be expected to have payloads, including satellites or experimental payloads. In addition to standard payloads, the Falcon 9 vehicle may carry a capsule, the SpaceX Dragon capsule (Figure 2-3), which is being developed to deliver cargo. The Dragon

Table 2-1. General characteristics of launch vehicles, including the Falcon 9 and Falcon 9 Heavy.

Launch Vehicle	Falcon 1	Falcon 9	Falcon 9 Heavy	Atlas IIAS	Atlas V*	Delta IV	Titan IV
Length	68 ft	178 ft	180 ft	156 ft	194 ft	230 ft	183 ft
Width	5.5 ft	12 ft	12 ft, with two 12-ft boosters	10 ft	12.5 ft	16.4 ft	14 ft
Stages	2	2	2	2	2 + 1 SRM	2	2 + 2 SRM †
First Stage Propellant	LOX/RP-1	LOX/RP-1	LOX/RP-1	LOX/RP-1	LOX/RP-1	LOX/LH_2	Liquid and solid*
Weight	60,000 lbs	693,000 lbs	1,950,000 lbs	413,500 lbs	774,000 lbs	1,630,000 lbs	2,070,000 lbs
Thrust at Lift-off	454 KN/ 102 Klbf	4,940 KN/ 1,111 Klbf	15,000 KN/ 3,375 Klbf	3,546 KN/ 797 Klbf	2,891 KN/ 650 Klbf	2,891 KN 650 Klbf	15,100 KN/ 3,400 Klbf††

Notes: SRM = solid rocket motor; LH_2 = liquid hydrogen; KN = kilonewtons; Klbf = kilopounds-force

* Indicates these characteristics are for the Atlas V 411 configuration, such as flown for the Atlas V NROL-28 launch.

† Indicates Titan IV first stage contains a core rocket engine using hypergolic propellants and two solid rocket motors using 88% Hydroxyl Terminated Polybutadiene fuels.

†† Indicates thrust level was from Titan IVB-12 launch.

capsule's dry weight could range from 8,000 to 15,000 lbs depending on its cargo and configuration. Dry weight is the weight of the payload without the associated propellant weight. Most payloads would almost always include some additional propellants on board, either for orbit maintenance or orbital insertion burns. A small amount of ordnance, such as small explosive bolts and on-board batteries would also typically be used.

Payload propellants may include hypergolic fuels such as unsymmetrical dimethyl hydrazine (UDMH), monomethylhydrazine (MMH) and nitrogen tetroxide (NTO), as well as pressurized gasses including helium and nitrogen, and some solid propellants. Quantities would vary but could total up to 4,840 lbs for combined weight of MMH and NTO for the Falcon 9, and up to 12,000 lbs for the Falcon 9 Heavy. The propellant weight for the Dragon capsule is relatively fixed and is approximately 2,850 lbs. Total payload weights (dry weight plus propellant weights) could be up to 17,850 lbs for the Falcon 9 and 24,000 lbs for the Falcon 9 Heavy. Prior to use, propellants would be stored in a certified facility and any residual propellants would be returned to the storage facility. Any hazardous materials stored on Base would be

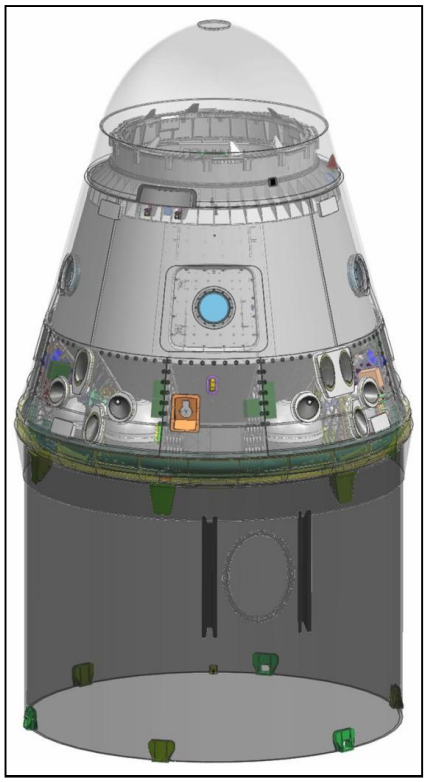

Figure 2-3. Drawing of the Falcon payload capsule, the Dragon, in launch configuration.

handled in accordance with federal, state, and local laws and regulations and 30 SW guidance.

The NASA Routine Payload Final EA (NASA 2002) addresses the concept of an "envelope spacecraft" which came from the need to provide a benchmark describing a bounding case for quantities and types of materials, emissions, and instrumentation. In addition, insofar as the pre-launch activities that are required to prepare routine payload spacecraft for launch are routine and not unusual, those activities were implicitly bounded by that envelope spacecraft as well (NASA 2002).

The quantitative levels noted for the envelope spacecraft payload characteristics were derived from a review of NASA and USAF payloads planned for launch during the 2002·to 2012 period using expendable launch vehicles (NASA 2002). Requirements that must be met by envelope spacecraft payloads are discussed in detail in the NASA Routine Payload Final EA (NASA 2002). Payloads incorporating characteristics with unusual or high potential for substantial environmental impact, such as the use of radioisotope thermoelectric generators and radioisotope heater units as well as the equipment and operations associated with extraterrestrial sample return, were excluded. Of the remaining proposed payloads, spacecraft systems with minor potential for environmental impact were identified and evaluated for:

- Solid, liquid, and electric (ion) propellant types and quantities
- Laser power levels and operating characteristics
- Explosive hazard potentials
- Battery electrolyte types and quantities
- Hazardous structural materials quantities
- Radio frequency transmitter power
- Radioisotope instrument components (e.g. calibration sources)

A theoretical "envelope" payload was defined by the magnitudes of all of these characteristics equal to the maximum found in all the reviewed payloads, increased by 25 percent to reasonably allow for future growth potential (NASA 2002).

The envelope spacecraft, would be launched into Earth's orbit or toward another body in the solar system. Table 2-2 presents the maximum quantities of materials that would be carried by the envelope spacecraft. Minor materials that are not listed may be included on the envelope spacecraft as long as they pose no substantial hazard (NASA 2002).

Payloads are not expected to include substantial amounts of radioactive materials. In most instances there would be no such materials on board. In a few instances there may be micro-curie amounts in instrument calibration sources and detectors. Required wattages necessary for payload transmitters would be determined on a mission by mission basis.

For the Falcon 9 and Falcon 9 Heavy, if candidate NASA payload characteristics do not fall within the parameters covered under those previously analyzed in the NASA Routine Payload Final EA (NASA 2002), NASA would need to complete additional analysis to address any hazards associated with the payload.

Primary Payload Processing

SpaceX anticipates that primary commercial payload processing would occur at the Astrotech facility, located on North Base, or at another commercial facility on Base, depending on the spacecraft customer. Processing of government payloads would be conducted in either commercial facilities or in government facilities on VAFB. Payloads that would not require extensive processing facilities could be processed exclusively in the Integration and Processing Hangar at SLC-4E.

Primary payload processing activities in any of these locations could include payload checkout, spacecraft propellant loading, and payload encapsulation in the fairing.

Table 2-2. Summary of NASA envelope spacecraft subsystems and envelope payload characteristics.

Structure	Unlimited: aluminum, magnesium, carbon resin composites, and titanium Limited: beryllium (110 lbs)
Propulsion	Mono- and bipropellant fuel; 2,200 lbs (hydrazine) 2,200 lbs (monomethyhydrazine) Bipropellant oxidizer; 2,640 lbs (nitrogen tetroxide) Ion-electric fuel; 1,100 lbs (Xenon) Solid rocket motor; 1,320 lbs (ammonium perchlorate-based solid propellant
Communications	Various 10-100 watt radio frequency transmitters
Power	Solar cells; 150 amp hour (nickel-hydrogen) battery; 300 amp hour (lithium-thionyl chloride) battery; 150 amp hour (nickel cadmium) battery
Science Instruments	10 kilowatt radar American National Standards Institute safe lasers
Other	Class C electro explosive devices for mechanical systems development Radioisotopes limited to quantities within the signature authority of the NASA Nuclear Flight Safety Assurance Manager Propulsion system exhaust and inert gas venting

Radiofrequency radiation of payloads would occur to verify payload communications systems prior to encapsulation. Hazardous materials used with payloads would be handled per federal, state, and local laws and regulations, and per VAFB environmental and safety standards. An emergency response team would be established and spills would be contained and cleaned up per the procedures identified in the VAFB Hazardous Materials Emergency Response Plan.

Once primary payload processing was accomplished, the payload would be trucked to SLC-4E prior to launch. Transport trucks would adhere to all DOT requirements.

2.1.1.5 Launch Vehicle and Payload Support Facilities

The following facilities and structures would be used during Falcon 9 and Falcon 9 Heavy program operations.

Integration and Processing Hangar

Once any necessary initial payload processing was completed, payloads would be transferred to the Integration and Processing Hangar (Figure 2-4), an industrial/warehouse facility with two bridge cranes. Payloads would be delivered to the Hangar for final payload processing and vehicle assembly. The Hangar and immediate vicinity would be used for all unloading, storage, and any necessary final payload processing. The bridge cranes would be used during the integration of the launch vehicle and its payload. The Hangar's site plan would be reviewed by the 30 SW/SE office to ensure proper placement of storage and processing areas. Approved safety procedures, to accommodate both non-hazardous and hazardous payload processing, such as ordnance installation and loading of liquid propellants onto the second stage, would be in place. The Hangar would be certified to meet National Fire Protection Association (NFPA) fire protection requirements for electrical systems and equipment, including crane consoles.

Launch Pad

The launch platform would be the concrete pad over the flame bucket that currently exists at SLC-4E, with a launch mount and the surround upper deck. The Falcon vehicle system transporter-erector (Figure 2-5) would serve as the service tower for vehicle umbilical support while the vehicle is vertical. Just before launch, the transporter-erector strong back would be retracted at least 12 degrees from the vehicle.

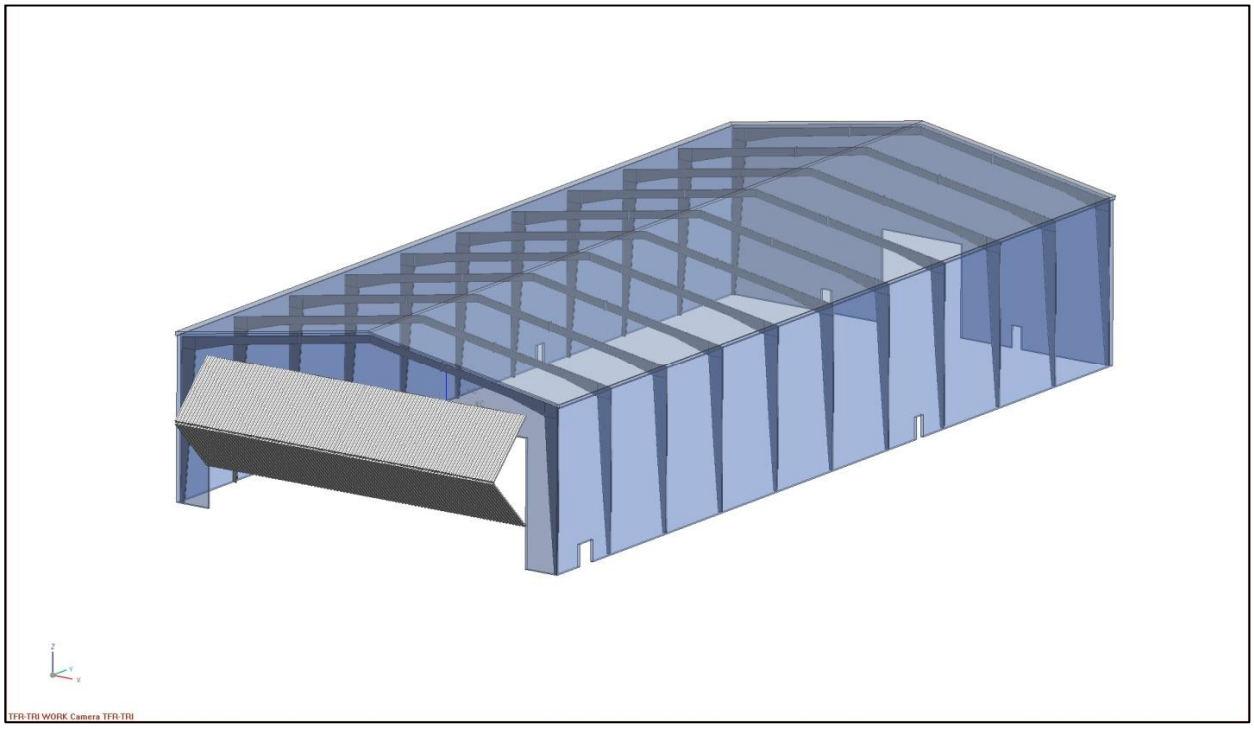

Figure 2-4. Diagram of the proposed Integration and Processing Hangar.

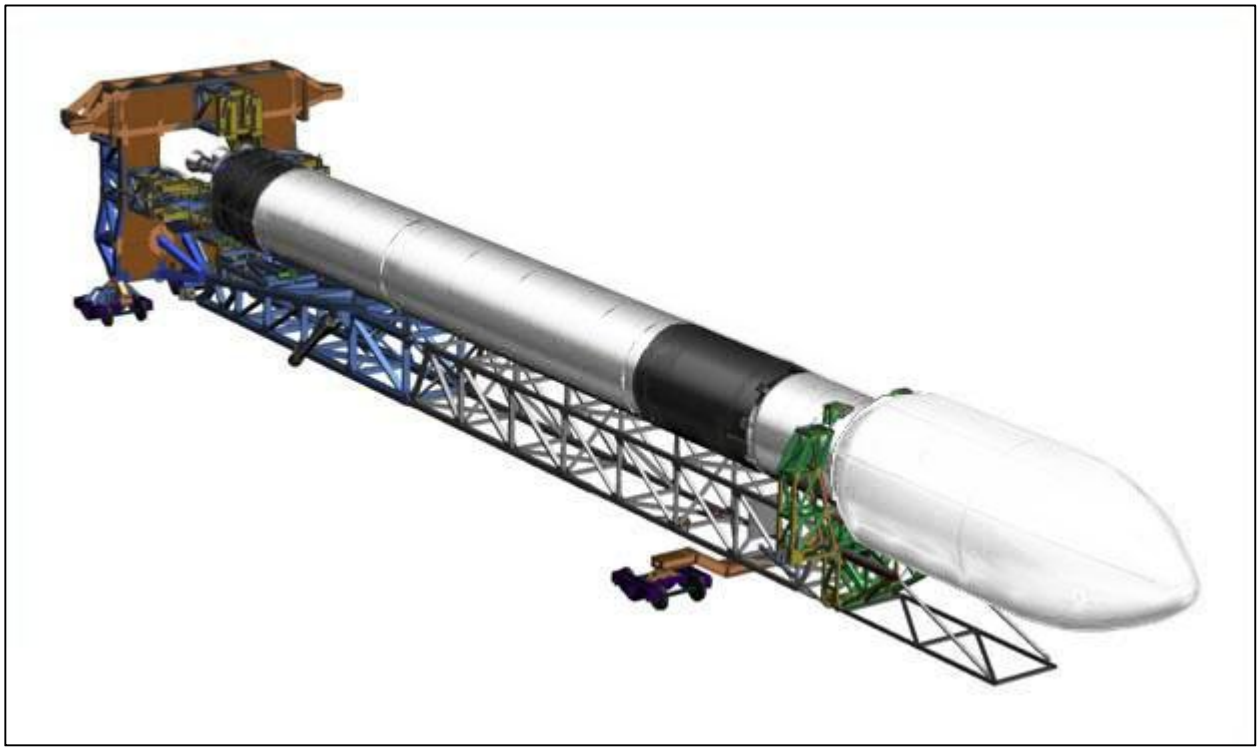

Figure 2-5. Drawing of the Falcon 9 vehicle, with a 16-ft payload fairing, on the transporter-erector.

The transporter-erector would be painted initially, and again as needed between launches, with a non-toxic paint to prevent corrosion of the structure. Mechanical means would be used to remove old paint from the transporter-erector. All paint chips and dust would be collected in a vacuum system for testing and disposal. The transporter-erector would be moved into the Hangar between launches.

Deluge Water System

SpaceX intends to utilize the existing deluge water system at SLC-4E. It would be refurbished based on its condition and design. The thrust energies of both the Falcon 9 (1.01 million pounds [Mlbs] of lift-off thrust) and the Falcon 9 Heavy (2.5 Mlbs of lift-off thrust) first stage engines are less than that of the Titan IV launch vehicle (3.3 Mlbs of lift-off thrust) that was previously launched from SLC-4E. Therefore, the current deluge system size would not be increased.

Deluge water systems are used widely throughout VAFB at other launch complexes for noise and vibration suppression; those systems normally discharge approximately 100,000 to 300,000 gallons per test/launch activity. During a Falcon 9 launch activity, the deluge system would discharge approximately 30,000 gallons. During a Falcon 9 Heavy launch activity, up to 80,000 gallons would be discharged. During launch, all water not vaporized and expelled would be contained in the retention basin and analyzed to determine if it meets the standards that would allow it to be discharged to grade. Water containing prohibited chemical levels would be removed and hauled to an approved industrial wastewater treatment facility outside of VAFB (see Section 4.10, Water Resources). The ground cloud formed by the steam during a launch would not contain any hazardous materials.

Gas, Fuel, Oil, and Solvent Storage Areas

Helium would be used as a pressurant for the main tanks during flight. It would also be used as a purge during fueling operations and at engine start. Helium would be obtained from commercial sources via tanker, and would be stored in a 30 SW/SE approved location within the SLC-4E fence line, in standard American Society of Mechanical Engineers (ASME)-certified storage tanks. Alternatively, if helium was reasonably available from government or commercial sources already present at SLC-4E, this source could be utilized with 30 SW approval.

LOX and RP-1 would be stored in the current propellant storage areas on SLC-4E (Figure 2-6). The Falcon 9 vehicle requires approximately 46,000 gallons of LOX and 35,000 gallons of RP-1. Eventually storage would be required for the quantities used by the Falcon 9 Heavy vehicle. Storage tanks with capacities of up to 250,000 gallons for LOX, and 100,000 gallons for RP-1 are anticipated. Storage areas at SLC-4E would be expanded if there was insufficient space. The storage locations for all Falcon program liquid propellants would afford the appropriate level of separation and protection.

All existing tanks and containment systems would be cleaned, tested, and recertified before first use; all tanks would be tested to ASME Section VIII Pressure Vessel Code requirements or American Petroleum Institute (API) storage tank requirements as applicable. Permanent over-ground lines would be installed to connect both the LOX and the RP-1 storage areas to the launch pad. These piping systems would be designed, installed and tested in accordance with 30 SW/SE requirements and/or ASME B31.3 Piping Code requirements.

First and second stage fueling of RP-1 and LOX would be done with standard quick disconnect fittings typically used in the aerospace industry. Gaseous nitrogen would be used on the system for cleanliness purges and liquid nitrogen would be used for cooling purges on an as-needed basis. Gaseous nitrogen would be drawn from the VAFB range supply system, if available at a reasonable cost, or obtained from a commercial source and transported to SLC-4E via tanker. Transport trucks would

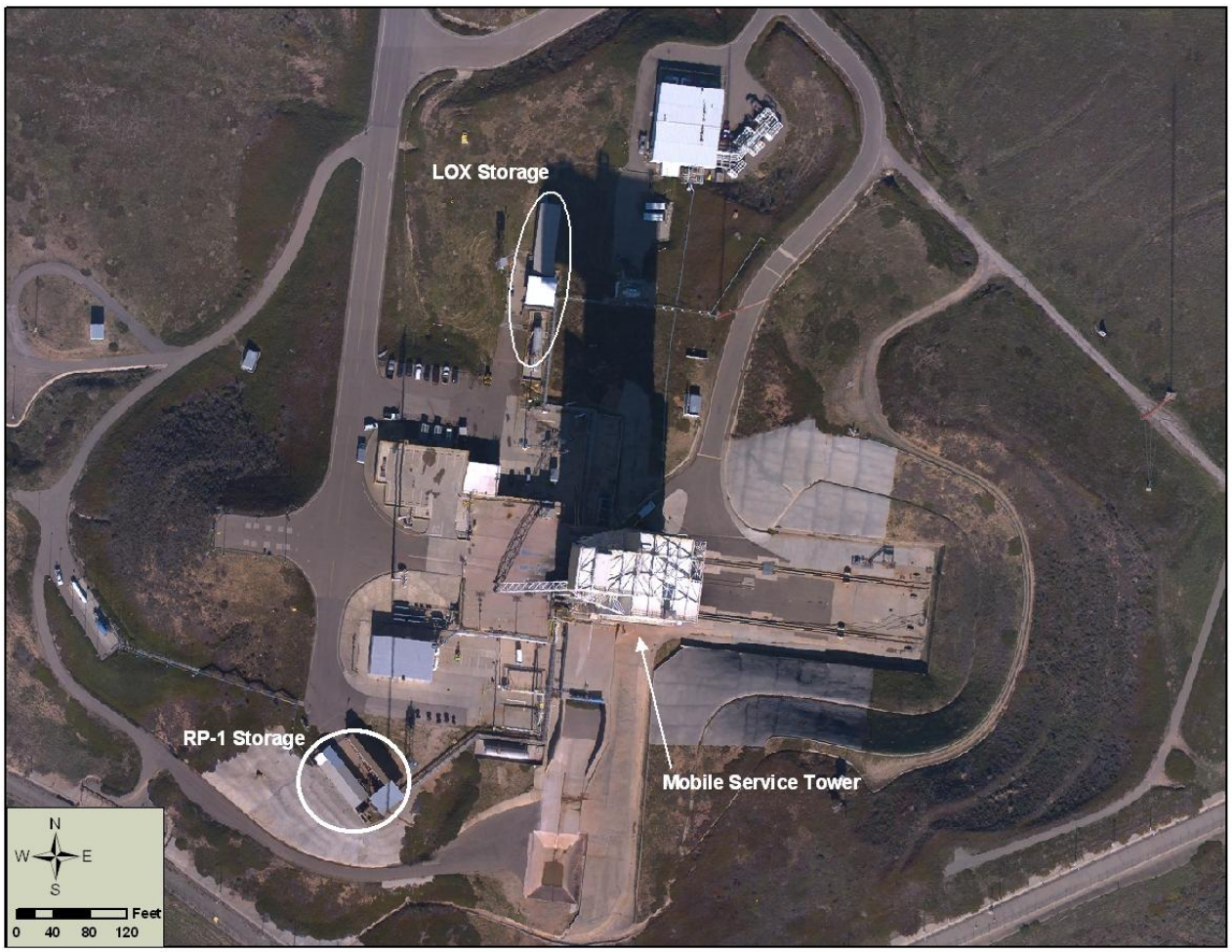

Figure 2-6. Current LOX and RP-1 storage areas at SLC-4E.

adhere to all DOT regulations applicable to the transport of gaseous nitrogen.

In addition, 25 gallons of isopropyl alcohol (IPA) would be on site per launch for additional cleaning operations, though only 5 gallons are estimated to be required for various cleaning operations during launch preparation. No solvent flushes would be performed during operation of the launch vehicle programs.

Small volumes (less than 300 gallons) of heavy gear oil, hydraulic oil, kerosene and cutting oil (less than 1 gallon), and a limited supply of various solvents and adhesives would be stored in the shop area in the Hangar or at the pad for general use in the maintenance of ground equipment. An oxygen/acetylene torch with its associated gases (carbon dioxide [CO_2] and argon gases) may also be used on a limited basis. Welding equipment would be maintained on site for occasional use.

2.1.1.6 Manning Levels and Launch Operations

On a per-mission basis, launch campaigns (preparation for and the actual launch event) are expected to last from 2 to 8 weeks. During a launch campaign, up to 100 local and 100 transient employees would be present at SLC-4E, including payload support

personnel. Between launch campaigns, 30 to 50 employees would be present at the site.

Ground transportation support during a launch campaign would be minimal. It would consist of a truck to deliver the crane (if an external crane is required outside the Hangar or if the Hangar cranes are not yet complete) and four delivery trucks for delivery of the first stage, second stage, interstage, and payload. Trucks could be oversized, up to 140 ft long and 16.5 ft wide. In addition, fuel and helium trucks would make weekly deliveries. Personal vehicles would be used by employees to commute locally on and off the site.

Launch site operations and vehicle processing for the Falcon 9 and the Falcon 9 Heavy would be virtually identical. The first and second stages would arrive separately, from Hawthorne, California, most likely via truck or rail, and would be placed in the Integration and Processing Hangar. Once at the Hangar, the stages and boosters would be checked and prepared for mating. The second stage, used on both the Falcon 9 and Falcon 9 Heavy, uses hypergolic propellants for re-entry burns. Fueling of this second stage would occur at the Hangar. During vehicle operations, and vehicle integration and checkouts, radiating in radio frequency bands would occur. Only non-ionizing radiation would be used.

Upon completing any necessary primary payload processing, the payload would be delivered to the Hangar. The payload would then be mated to the launch vehicle. Figure 2-5 depicts a 16.5-ft payload on the Falcon 9 vehicle, as loaded on the transporter-erector.

After final systems checkout, there would typically be a mission rehearsal without propellants on board (dry) plus a mission rehearsal with propellants on the vehicle (wet) to verify full launch readiness. Two dress rehearsals (usually within 32 days of launch) are typical in the launch preparation schedule to allow for team training and for coordination of activities between the SpaceX crew and VAFB personnel. Wet dress rehearsals would require local closures or restricted access during the rehearsal. Under some circumstances, static fire tests of both vehicles may be conducted at the launch site, where the vehicle is fully fueled and the engine ignited and run for up to 5 seconds as a thorough test of all systems.

Approximately 6 days prior to launch, the launch vehicle on the transporter-erector, would be moved to the launch pad and connected to the launch stand. A wheeled vehicle, such as a small tug or other road equipment, would be used to pull the launch vehicle and transporter-erector along tracks to the launch pad. The launch vehicle would then undergo an additional series of tests while horizontal or vertical at the pad. Vehicles may be erected and de-erected several times prior to launch; the transporter-erector is designed to make this operation quick and simple. The day of launch, the vehicle would be erected and final checks completed.

2.1.1.7 Safety Systems

Safety plans would be developed specifically for the Falcon 9 and Falcon 9 Heavy launch vehicle programs. This would ensure all launch operations are in compliance with all regulations applicable to commercial operations and as specified in numerous compliance documents and by various 30 SW organizations, including but not limited to:

- AFSPCMAN 91-710, *Range Safety Requirements*, as tailored for the Falcon 9 and 9 Heavy launch vehicle programs;
- Department of Defense (DOD) 6055.9-Standard (STD), *DoD Ammunition and Explosives Safety Standards*, per AFSPCMAN 91-710;
- 30th Space Wing Instruction (SWI) 32-102, *Fire Prevention*;
- Air Force Instruction (AFI) 91-110, *Nuclear Safety Review and Launch Approval for Space or Missile Use of Radioactive Material and Nuclear Systems*; Supplement 1 to AFI 91-110, AFI 40-201, *Managing Radioactive Material in the U.S. Air Force*;

and 30 SWI 40-101, *Managing Radioactive Material on VAFB* (for minute amounts of radioactive materials potentially present in scientific equipment on payloads);

- 30 SWI 31-101, *Installation Security Instructions*; AFI 31-101, *The Air Force Installation Security Program*; and DOD 5220.22-M, *National Industrial Security Program Operating Manual* (for DOD missions only);
- AFI 32-1023, *Design and Construction Standards and Execution of Facility Construction Projects*;
- Air Force Occupational Safety and Health (AFOSH) Standards (for DOD missions only);
- NFPA National Fire Codes;
- American National Standards Institute standards; and
- Occupational Safety and Health Administration (OSHA) regulations.

AFSPCMAN 91-710 defines overall safety regulations for VAFB. This document is tailored for each launch program. All tailoring would be performed with the 30 SW/SE organizations and approved by them. The objective of the 30 SW/SE office is to ensure that the general public, land masses, and launch area resources are afforded an acceptable level of safety, and that all aspects of pre-launch and launch operations adhere to public law. AFSPCMAN 91-710 provides a framework for review and approval of all hazards associated with construction, pre-launch and launch operations, and incorporates all Air Force, DOD, and other applicable health and safety standards. As SpaceX is awarded specific launch contracts with various DOD or military launch organizations, additional applicable safety standards and specifications would apply, and would be incorporated to the program as required.

Security procedures at SLC-4E would be performed according to Air Force requirements specified in the Commercial Space Operations Support Agreement (CSOSA; VAFB 2007b) and contained in 30 SWI 31-101, AFI 31-101, and DOD 5220.22-M, as applicable for commercial operations.

In the event of a launch anomaly, SpaceX would coordinate and work with the Air Force and appropriate regulatory agencies to assess the effects of such an event on all resources, to implement clean-up operations, and to mitigate if necessary for adverse impacts.

Debris Analysis

As part of the safety review process, a Falcon 9 debris model was completed and is available for review upon request. The debris analysis was developed to comply with AFSPCMAN 91-710 and presents estimated debris lists for flight termination system activation, explosions, and aerodynamic breakup modes. Additionally, well in advance of any planned mission (launch), SpaceX would develop a Preliminary Flight Data Package (PFDP), which takes into consideration a trajectory that avoids over-flights of known structures such as oil rigs (if required), and establishes potential debris corridors for the vehicle (see Section 3.5, Human Health and Safety). Falcon vehicles are designed to be highly reliable because they minimize staging events and have an "engine out" capability, allowing the vehicle to continue with one failed engine in flight (SpaceX 2007).

2.1.1.8 Recovery Efforts

First Stage

The first stage recovery location would vary, both in distance and direction of the splash down area, depending on the trajectory of the launch vehicle. It is anticipated that the first stage would drop by parachute into the Pacific Ocean between 300 and 500 miles west of the California coast (in all launch azimuth directions). It would be recovered by a salvage ship that, during the launch event, would be stationed in a 30 SW Launch Safety (30 SW/SEL) designated safety zone near the anticipated area of impact. The salvage ship would be able to locate the first stage by

homing in on a transmitter that signals the global positioning system (GPS) location, and/or by strobe light. Recovery operations would consist of using divers to inspect the stage, installing safing pins if required, and installing the stage into the towing skid for transport to the nearest harbor facility, most likely the Long Beach Harbor. Once there, the stage would be lifted onto the dock area. If the expended first stage could not be located, it would likely be because it had been damaged. It would subsequently sink and therefore would not be recovered.

Although propellants would be burned to depletion during flight, there is a potential for approximately 8 gallons of LOX and a maximum of 67.5 gallons of RP-1 to remain in the expended Falcon 9 first stage, and a maximum of 202.5 gallons of RP-1 in the Falcon 9 Heavy first stage. The tanks are designed so these chemicals would not be released into the ocean on impact. The LOX residue would dissipate as gaseous oxygen, while the RP-1 residue is anticipated to remain trapped within the fuel tank. If RP-1 did escape, the residue would float on the surface of the ocean and dissipate within hours.

Any recovered first stages would be returned to the SpaceX facilities in Hawthorne, California via truck. The recovered first stage would be used as a source of information for continuous program improvement. Reuse is also a possible option after first stage recovery.

Second Stage

The second stage would go into orbit with the payload. The Falcon 9 second stage, used for both standard and heavy vehicles, is designed to be recoverable. In this event, the stage would re-enter the atmosphere upon a pre-programmed trajectory and impact in a pre-determined position dependent on the mission. This location would be a minimum of 50 miles from the nearest coastline and/or land, but could be located in any broad ocean area. This is because the trajectories flown from VAFB result in polar orbits – meaning that any ocean area is available for recovery. Active sea lanes and other populated areas would be avoided per flight safety requirements to minimize risk to populations. Attempts would be made to use standard recovery areas off the Pacific Coast of California and Mexico and to minimize recovery infrastructure requirements; however recovery locations would be chosen on a mission by mission basis. The recovery vessel would take the second stage to the nearest harbor facility, where the stage would be lifted onto a truck and shipped to a SpaceX facility for processing.

Dragon Capsule Re-Entry and Recovery

For launches from VAFB, the Dragon capsule was designed to carry cargo only and not crew personnel. After completion of its mission to deliver cargo, the Dragon would re-enter the atmosphere on a pre-planned trajectory and be tracked to a soft-landing in the ocean. Landing and recovery is planned to occur in international waters within any ocean body; areas for landing and recovery would be dependent upon mission requirements. Specific details for each recovery would be coordinated at that time with the DOD, NASA, or the FAA, depending on the mission.

The Dragon has an electronic locator beacon and would be located and recovered by a pre-positioned salvage vessel contracted by SpaceX (similar to the recovery of the first and second stages). Recovery would occur within 24 hours of re-entry. The Dragon could land with a variable amount of propellant on board, depending on the mission; it is anticipated that less than 50 gallons of each propellant would remain at the time of landing regardless of the mission. Off-loading of the residual propellants would occur either on the recovery vessel, at a secure contained location within one of the SLC-4E facilities. If recovery occurs in an area far away from the California coast, a commercial facility in the vicinity of the recovery site may be used. All locations for off-load will include spill containment and handling equipment, and will implement procedures appropriate for the propellants involved. After off-loading the

residual propellants, the capsule would be taken to Hawthorne, California, where it may or may not be refurbished and re-used.

2.1.1.9 Projected Launch Schedule

When operations begin at SLC-4E, currently anticipated for 2012, up to four launches of the Falcon 9 would be conducted per year. As the program matures, there could be a potential of 10 launches per year, one-half being Falcon 9 launches and one-half being Falcon 9 Heavy launches. Presently, the Air Force is anticipating issuing a renewable 5-year lease of SLC-4E to SpaceX.

2.1.2 Modification of SLC-4E

Prior to any modification of SLC-4E, 30 SW Civil Engineering Squadron (30 CES) and 30 SW/SE at VAFB would review the design plans for refurbishment and construction to ensure compliance with AFSPCMAN 91-710 and Air Force Manual (AFMAN) 91-201, *Explosives Safety Standards.* Evacuation plans, aboveground storage tanks (AST) locations, drain system location, placement of storage and processing areas, and planned ground operations to establish safe clearance zones, would be designed to comply with all appropriate regulations.

2.1.2.1 Demolition of Existing Facilities

SpaceX anticipates that the following existing facilities or structures would be demolished during the modification of SLC-4E (property numbers are indicated in parenthesis):

- SLC-4E fuel incinerator pad (714)
- SLC-4E mobile service tower (715, but retain the additional structures under this property number)
- SLC-4E clean room heating, ventilation, and air conditioning (HVAC) plant (719)
- Oxidizer scrubber pad (726)

At the following facilities, SpaceX anticipates demolishing the structures but retaining the underlying concrete pads:

- SLC-4E fuel transfer pad (713)
- SLC-4E fuel holding area (716)
- SLC-4E oxidizer hold area (722)

Demolition of these facilities at SLC-4E was previously assessed (VAFB 2005), and is not covered under this EA. SpaceX anticipates accomplishing this demolition and funding it to meet their projected launch schedule. They would coordinate all efforts with the appropriate 30 SW offices.

2.1.2.2 Modification of Existing Facilities

SpaceX proposes to make modifications to the existing site at SLC-4E. Modifications could include administrative building improvements, propellant tank installation, reinstallation (or re-initiation) of utilities, resurfacing of the launch water deluge drainage and retention basin, and resurfacing of the entrance road. The security system at SLC-4E would be refurbished, if required. The extent of the modifications required would be determined after a detailed site inspection. All work would be restricted to areas inside or near previously disturbed areas of SLC-4E and the entrance road.

As mentioned above, SpaceX anticipates reinstalling or re-initiating utilities at the site. When possible and as agreed upon with VAFB, SpaceX would tie into existing VAFB-supplied utilities, such as water, power, and high pressure gaseous nitrogen supply.

In addition to the VAFB power supply, two 200 kilovolt amperes (KVa) diesel generators would be used for emergency back-up purposes during launch operations. One generator would be positioned near or on the launch pad while the other would be near the office facilities. Each generator would be anticipated to operate for a maximum of 336 hours per year, which would include emergency back-up operations and monthly maintenance activities (Table 2-3).

2.1.2.3 New Construction

SpaceX plans to utilize existing facilities, structures, and utility connections where possible at SLC-4E. A new Integration and Processing Hangar would be constructed at

Table 2-3. Emergency generator usage.

Description	Event Hrs	Annual Hrs*
Monthly Maintenance	3	36
Testing prior to launch	6	60*
Launch day emergency backup	24	240**
Total Annual Usage per Generator		**336**

Notes:
* Assumes maximum of 10 launches per year.
** Emergency backup on launch day with automatic failover system.

SLC-4E within the current perimeter of the complex. This facility would require approximately 30,000 square feet (ft^2) of space (250 by 120 by 75 ft high) plus up to approximately 50 by 150 ft of paved area for vehicle maneuvering, and a 20 ft access road by the side of the Hangar. A conceptual layout of the facility is shown in Figure 2-4.

The Hangar would be constructed of pre-fabricated steel framework with steel or aluminum sheet walls. The facility would be air conditioned, and the fueling facilities would have a scrubber system to minimize emissions to the environment in the event of a payload fuel spill inside the facility.

Construction and operation of ventilation systems would adhere to California EPA permitting requirements. The Hangar would be constructed in accordance with all applicable Air Force and OSHA regulations.

The Hangar would be located at one of two locations, as shown in Figure 2-7. It is essential that the Hangar to be located as close as possible to the launch pad to

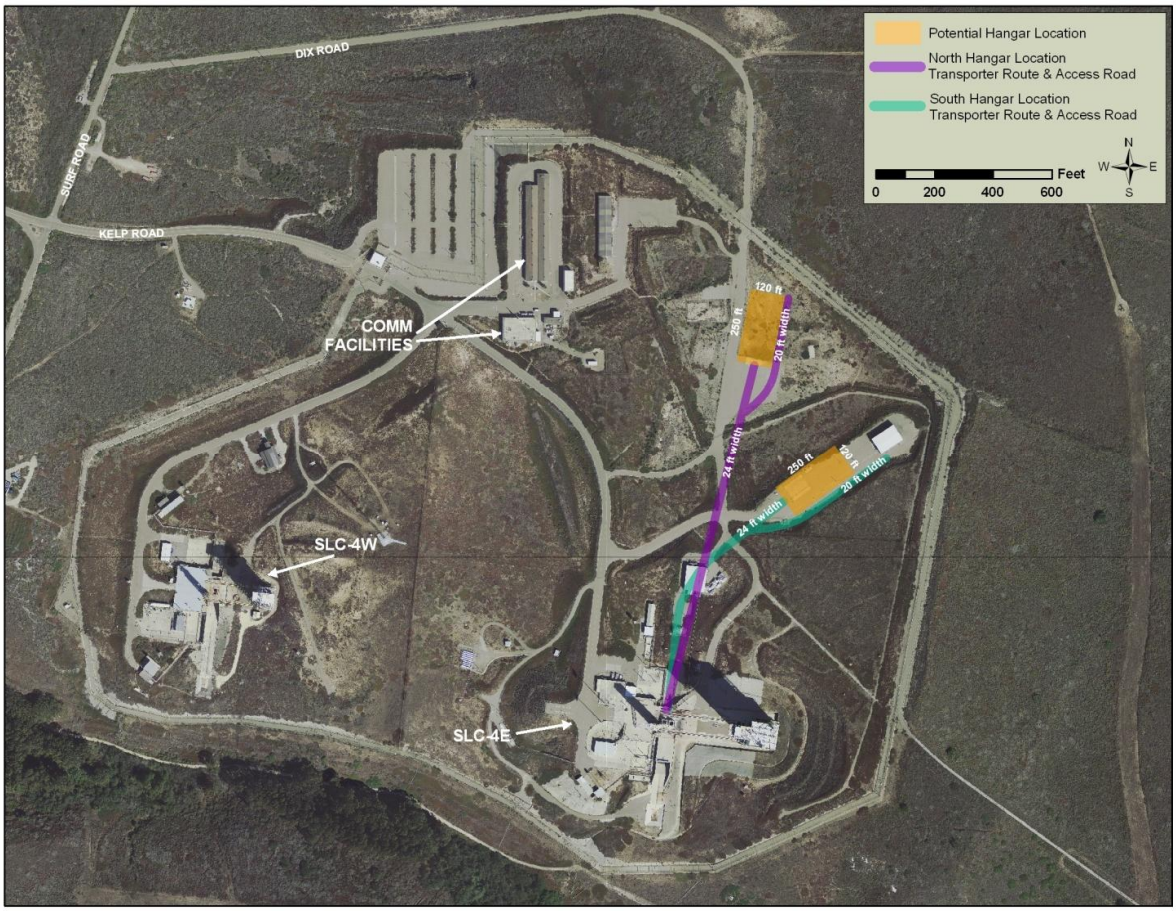

Figure 2-7. SLC-4 and potential Hangar locations, with transporter-erector routes.

minimize risks associated with moving the vehicle to the launch pad following its check-out at the Hangar. For this reason, the southerly location is preferable; however the final location would be determined based on factors including environmental impacts, cost to build, road grade, safety considerations, and others.

2.1.2.4 Manning Levels and Project Schedule

Modifications to SLC-4E, including the construction of the Hangar, would be anticipated to last approximately 24 months, once initial demolition of the existing mobile service tower was completed. Up to 100 local and 100 transient workers would be anticipated at SLC-4E during refurbishment and construction efforts.

2.1.2.5 Project Equipment Needs

Table 2-4 provides the estimated types of equipment that would be used for the proposed project. Although the exact type of equipment may vary slightly from these projections, these estimates provide a sound basis for analyzing related issues, such as air quality impacts.

Table 2-4. Estimated project equipment needs for modifications to SLC-4E.

Equipment	Capacity or Power	Hours of Anticipated Usage
Excavator – 50,000 lb class PC300 Komatsu	200 Hp	220 Hours
Loader – 4 yard 644 Deere	200 Hp	80 Hours
Water Truck – 2000 gallons Capacity	200 Hp	80 Hours
Dump Trucks – 12-20 yard Capacity	300 Hp	120 Hours
Road Grader – 12" Mold Board 670 Deere	15 Hp	100 Hours
Dozer – 850 Deere	170 Hp	100 Hours
Compactor – Ride on 8 Ton Vibratory	100 Hp	40 Hours
Forklift – All Terrain Telehandler 6000 lb	85 Hp	100 Hours
Crane – 75 Ton	200 Hp	10 Hours
Scraper – 623 Cat Wheel Tractor	330 Hp	100 Hours
Skid Loader with Drag – 210 Deere with Drag	65 Hp	100 Hours
Backhoe Loader – 410 Deere	85 Hp	60 Hours
Forklift – All Terrain Telehandler 6000 lb	85 Hp	100 Hours

Notes: Hp=Horsepower

2.2 No-Action Alternative

Under the No-Action Alternative, no modifications would be made to SLC-4E and the Falcon 9 and Falcon 9 Heavy launch vehicle programs would not operate from this site. SLC-4E would remain non-operational, thus, the existing environment would not be affected.

Under this alternative, the Commercial Space Launch Act goal to encourage the use of underutilized government infrastructure and resources to promote commercial investment and use of space would not be realized at VAFB. Additionally, SLC-4E would not be utilized to meet the National Space Policy goal of ensuring U.S. Government infrastructure is made available for commercial use on a reimbursable, noninterference, and equitable basis to the maximum practical extent. Lastly, the No-Action Alternative would restrict U.S. options for space launch into polar and sun-synchronous orbits, which are typically used for imaging, earth observation, and weather satellites.

2.3 Other Alternatives Considered

The following alternative locations for the Falcon 9 and Falcon 9 Heavy launch vehicle programs were identified and considered but eliminated from further analysis because they did not meet the criteria necessary for the Falcon 9 and Falcon 9 Heavy programs, or were precluded from use due to requirements of other programs, as described below.

2.3.1 Other VAFB Alternatives

2.3.1.1 SLC-3W

SLC-3W on VAFB was originally pursued by SpaceX as a launch site for the Falcon 1 program. In 2005, the Air Force Space Command (AFSPC) made a decision that SpaceX could not utilize this site for the Falcon 1 program due to its proximity to SLC-3E, which is utilized by the Atlas V program. Since the Atlas V program still exists at this site and the Falcon 9 vehicle is much larger than the Falcon 1 vehicle, this restriction still applies to the use of SLC-3E.

2.3.1.2 SLC-4W

SLC-4W was briefly considered but excluded from further analysis, as it does not have facilities with size or weight capabilities to support medium-lift class vehicle launches for the Falcon 9 and Falcon 9 Heavy programs. Modifications to SLC-4W would have to be extensive to accommodate the Falcon 9 and Falcon 9 Heavy programs.

2.3.2 Non-VAFB Alternatives

2.3.2.1 Kwajalein Atoll

SpaceX currently holds a commercial launch license for the Falcon launch vehicle at the Kwajalein Atoll. The Kwajalein Atoll, a group of islands located in the Pacific Ocean, approximately 2,100 nautical miles southwest of the Hawaiian Islands. It is the only U.S.-controlled equatorial launch site (U.S. Army Space and Missile Defense Command/U.S. Army Forces Strategic Command 2007). However the use of the Kwajalein Atoll presents significant logistical and operational problems. Rocket stage vehicles and payloads must endure a long overseas journey, and once at the Atoll, all systems and parts are subjected to a harsh, corrosive atmosphere which leads to a potential increase in system failures. While the Kwajalein Atoll is intended to remain as an alternative launch site, it is not suitable as a primary launch site for the rate of launches anticipated from VAFB. The use of VAFB would eliminate the logistical and operational problems associated with the Kwajalein Atoll, as well as provide facilities to support the desired launch rate, and allow for better mission reliability (as a result of less risk of system failures than at the Kwajalein Atoll). For these reasons, the Kwajalein Atoll was dismissed from further consideration as a primary launch location.

2.3.2.2 Guiana Space Center

The Guiana Space Center, in French Guiana near Kourou, is the launch site for the European Ariane vehicles. The Guiana Space Center, also known as the Spaceport, is a strategically located facility that provides the optimum operating conditions for Arianespace's commercial launches. Situated close to the equator, the Spaceport is ideally situated for missions into geostationary orbit. Launching near the equator reduces the energy required for orbit plane change maneuvers. This saves fuel, enabling an increased operational lifetime for Ariane satellite payloads, and in turn, an improved return on investment for the spacecraft operators. The French Guiana coastline's shape allows for launches into all useful orbits from northward launches through eastward missions. However, significant obstacles exist from the U.S. State Department in transporting and operating U.S.-made launch vehicle equipment into foreign countries. Though the 2010 National Space Policy will hopefully reduce restrictions in the future, it has not yet done so. Presently, associated costs must still be born and are the difference between viable and non-viable programs from a commercial stand point. Currently, operations would be prohibitively expensive due to State Department International Traffic in Arms regulations. Therefore, the Guiana Space Center was dismissed from further consideration.

Chapter 3. Affected Environment

This chapter describes the existing environmental conditions near and within the Proposed Action site, and areas on VAFB that have the potential to be affected by the Proposed Action. The area considered for each resource was commensurate with the resource analyzed. Thus, while for some resources only the immediate area was considered, for others a wider regional area was used.

3.1 Air Quality

Air quality is defined by ambient air concentrations of specific pollutants determined by the U.S. EPA to be of concern with respect to the health and welfare of the general public. Seven major pollutants of concern, called "criteria pollutants," are carbon monoxide (CO), sulfur dioxide (SO_2), nitrogen dioxide (NO_2), ozone (O_3), suspended particulate matter less than or equal to 10 microns in diameter (PM_{10}), fine particulate matter less than or equal to 2.5 microns in diameter ($PM_{2.5}$), and lead (Pb). The U.S. EPA has established National Ambient Air Quality Standards (NAAQS) for these pollutants. Areas that violate a federal air quality standard are designated as non-attainment areas.

Ambient air quality refers to the atmospheric concentration of a specific compound (amount of pollutants in a specified volume of air) that occurs at a particular geographic location. The ambient air quality levels measured at a particular location are determined by the interactions of emissions, meteorology, and chemistry. Emission considerations include the types, amounts, and locations of pollutants emitted into the atmosphere. Meteorological considerations include wind and precipitation patterns affecting the distribution, dilution, and removal of pollutant emissions. Chemical reactions can transform pollutant emissions into other chemical substances. Ambient air quality data are generally reported as a mass per unit volume (e.g., micrograms per cubic meter of air) or as a volume fraction (e.g., parts per million [ppm] by volume).

Pollutant emissions typically refer to the amount of pollutants or pollutant precursors introduced into the atmosphere by a source or group of sources. Pollutant emissions contribute to the ambient air concentrations of criteria pollutants, either by directly affecting the pollutant concentrations measured in the ambient air or by interacting in the atmosphere to form criteria pollutants. Primary pollutants, such as CO, SO_2, Pb, and some particulates, are emitted directly into the atmosphere from emission sources. Secondary pollutants, such as O_3, NO_2, and some particulates, are formed through atmospheric chemical reactions that are influenced by meteorology, ultraviolet light, and other atmospheric processes. PM_{10} and $PM_{2.5}$ are generated as primary pollutants by various mechanical processes (e.g., abrasion, erosion, mixing, or atomization) or combustion processes. However, PM_{10} and $PM_{2.5}$ can also be formed as secondary pollutants through chemical reactions or by gaseous pollutants condensing into fine aerosols. In general, emissions that are considered "precursors" to secondary pollutants in the atmosphere (such as reactive organic gases [ROG] and oxides of nitrogen [NOx], which are considered precursors for O_3), are the pollutants for which emissions are evaluated to control the level of O_3 in the ambient air.

The State of California has identified four additional pollutants for ambient air quality standards: visibility reducing particles, sulfates, hydrogen sulfide, and vinyl chloride. The California Air Resources Board (CARB) has also established the more stringent

California Ambient Air Quality Standards (CAAQS). Areas within California in which ambient air concentrations of a pollutant are higher than the state and/or federal standard are considered to be non-attainment for that pollutant. Table 3-1 shows both the federal and state ambient air quality standards.

Toxic air pollutants, also called hazardous air pollutants (HAPs), are a class of pollutants that do not have ambient air quality standards but are examined on an individual basis when there is a source of these pollutants. The State of California has identified particulate emissions from diesel engines as a toxic air pollutant.

Global temperatures are moderated by naturally occurring atmospheric gases, including water vapor, CO_2, methane (CH_4) and nitrous oxide (N_2O), which are known as greenhouse gases (GHG). These gases allow solar radiation (sunlight) into the Earth's atmosphere, but prevent radiative heat from escaping, thus warming the Earth's atmosphere. Gases that trap heat in the atmosphere are often called GHG, analogous to a greenhouse. GHG are emitted by both natural processes and human activities. State law defines GHG as any of the following compounds: CO_2, CH_4, N_2O, hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), sulfur hexafluoride (SF_6), and nitrogen trifluoride (California Health and Safety Code Section 38505[g]). GHG have varying global warming potential (GWP). The GWP is the potential of a gas or aerosol to trap heat in the atmosphere; it is the "cumulative radiative forcing effect of a gas over a specified time horizon resulting from the emission of a unit mass of gas relative to a reference gas" (U.S. EPA 2006). The reference gas for GWP is CO_2; therefore, CO_2 has a GWP of 1. The other main GHG that have been attributed to human activity include CH_4, which has a GWP of 21, and N_2O, which has a GWP of 310. CO_2, followed by CH_4 and N_2O, are the most common GHG that result from human activity. CO_2, and to a lesser extent, CH_4 and N_2O, are products of combustion and are generated from stationary combustion sources as well as vehicles. High global warming potential gases include GHG that are used in refrigeration/cooling systems such as chlorofluorocarbons and HFCs.

3.1.1 Region of Influence

Specifically identifying the region of influence (ROI) for air quality requires knowledge of the type of pollutant, emission rates of the pollutant source, proximity to other emission sources, and local and regional meteorology. For inert pollutants (all pollutants other than ozone and its precursors), the ROI is generally limited to a few miles downwind from the source. However, for photochemical pollutants such as ozone, the ROI may extend much farther downwind. Ozone is a secondary pollutant that is formed in the atmosphere by photochemical reactions of previously emitted pollutants, or precursors (ROG, NOx, and PM_{10}). The maximum effect of precursors on ozone levels tends to occur several hours after the time of emission during periods of high solar load and may occur many miles from the source. Ozone and ozone precursors transported from other regions can also combine with local emissions to produce high local ozone concentrations. The ROI for the Falcon 9 and Falcon 9 Heavy launch vehicle programs includes the South Central Coast Air Basin (SCCAB).

3.1.2 Regional Setting

VAFB is within Santa Barbara County and under the jurisdiction of the SBCAPCD. The SBCAPCD is the agency responsible for the administration of federal and state air quality laws, regulations, and policies in Santa Barbara County, which is within the SCCAB. The SCCAB includes San Luis Obispo, Santa Barbara, and Ventura counties.

The SCCAB, and all of Southern California, lies in a semi-permanent high-pressure zone of the Eastern Pacific Region. The coastal area is characterized by sparse rainfall, most of which occurs in the winter season, and hot dry summers, tempered by cooling sea breezes. In Santa Barbara County, the months of heaviest precipitation are

Table 3-1. Ambient air quality standards.

Pollutant	Averaging Time	NAAQS[1]		CAAQS[2]
		Primary[3]	Secondary[4]	Concentration[5]
Ozone (O_3)[6]	8-hour	0.075 ppm	Same as Primary Standard	0.07 ppm (137 μg/m^3) Note[7]
	1-hour	--		0.09 ppm (180 μg/m^3)
Carbon Monoxide (CO)	8-hour	9 ppm (10 mg/m^3)	None	9.0 ppm (10 μg/m^3)
	1-hour	35 ppm (40 mg/m^3)		20.0 ppm (23 μg/m^3)
Nitrogen Dioxide (NO_2)	Annual Average	0.053 ppm (100 μg/m^3)	Same as Primary Standard	0.03 ppm (56 μg/m^3)
	1-hour	--		0.18 ppm (338 μg/m^3)
Sulfur Dioxide (SO_2)	Annual Average	0.03 ppm (80 μg/m^3)	--	--
	24-hour	0.14 ppm (365 μg/m^3)	--	0.04 ppm (105 μg/m^3)
	3-hour	--	0.5 ppm (1300 μg/m^3)	--
	1-hour	--	--	0.25 ppm (655 μg/m^3)
Suspended Particulate Matter (PM_{10})	Annual Arithmetic Mean	--	Same as Primary Standard	20 μg/m^3 (Note 8)
	24-hour	150 μg/m^3		50 μg/m^3
Fine Particulate Matter ($PM_{2.5}$)[6]	Annual Arithmetic Mean	15 μg/m^3	Same as Primary Standard	12 μg/m^3 (Note 8)
	24-hour	35 μg/m^3		--
Lead (Pb)[9]	30-day average	--	--	1.5 μg/m^3
	Calendar Quarter	1.5 μg/m^3	Same as Primary Standard	--
	3-month rolling average	0.15 μg/m^3		--
Hydrogen Sulfide (H_2S)	1-hour	No Federal Standards		0.03 ppm (42 μg/m^3)
Sulfates (SO_4)	24-hour			25 μg/m^3
Visibility Reducing Particles	8-hour (10 am to 6 pm, Pacific Standard Time)			In sufficient amount to produce an extinction coefficient of 0.23 per kilometer due to particles when the relative humidity is less than 70%.
Vinyl Chloride[9]	24-hour			0.01 ppm (26 μg/m^3)

Notes:

1. NAAQS (other than O_3, particulate matter, and those based on annual averages or annual arithmetic mean) are not to be exceeded more than once a year. The O_3 standard is attained when the fourth highest 8-hour concentration in a year, averaged over 3 years, is equal to or less than the standard. For PM_{10}, the 24-hour standard is attained when 99 percent of the daily concentrations, averaged over 3 years, are equal to or less than the standard. For $PM_{2.5}$, the 24-hour standard is attained when 98 percent of the daily concentrations, averaged over 3 years, are equal to or less than the standard. Contact the U.S. EPA for further clarification and current federal policies.
2. CAAQS for O_3, CO (except Lake Tahoe), SO_2 (1- and 24-hour), NO_2, PM_{10}, and visibility reducing particles, are values that are not to be exceeded. All others are not to be equaled or exceeded.
3. National Primary Standards: The levels of air quality necessary, with an adequate margin of safety, to protect the public health.
4. National Secondary Standards: The levels of air quality necessary to protect the public welfare from any known or anticipated adverse effects of a pollutant.
5. Concentration expressed first in units in which it was promulgated. Ppm in this table refers to ppm by volume or micromoles of pollutant per mole of gas.
6. New federal 8-hour ozone and fine particulate matter standards were promulgated by U.S. EPA on 18 July 1997. The federal 1-hour O_3 standard continues to apply in areas that violated the standard. On 15 April 2004, the U.S. EPA issued attainment designations for the 8-hour standard and described plans for the phase out of the 1-hour standard (U.S. EPA 2004).
7. Approved by the CARB on 28 April 2005 and became effective on 17 May 2006.
8. On 5 June 2003, the Office of Administrative Law approved the amendments to the regulations for the state ambient air quality standards for particulate matter and sulfates. Those amendments established a new annual average standard for $PM_{2.5}$ of 12 μg/m^3 and reduced the level of the annual average standard for PM_{10} to 20 μg/m^3. The approved amendments were filed with the Secretary of State on 5 June 2003. The regulations became effective on 5 July 2003.
9. The CARB has identified lead and vinyl chloride as 'toxic air contaminants' with no threshold level of exposure for adverse health effects determined. These actions allow for the implementation of control measures at levels below the ambient concentrations specified for these pollutants.

mg/m^3 – milligrams per cubic meter μg/m^3 = micrograms per cubic meter

Source: CARB 2009, U.S. EPA 2009a

November through April, averaging 14.66 inches annually. The mean temperature in the VAFB area, as reported by monitors in Lompoc, is 58.4°Fahrenheit (°F) and the mean maximum and mean minimum temperatures are 69.8°F and 47.1°F, respectively (Western Regional Climatic Center [WRCC] 2007).

Santa Barbara County is classified as an attainment/unclassified area for the NAAQS for all criteria pollutants. Santa Barbara County is considered a non-attainment area for the state 8-hour ozone standard. Santa Barbara County is classified as an attainment/unclassified area for the CAAQS for all other criteria pollutants.

The CARB and SBCAPCD operate a network of ambient air monitoring stations throughout Santa Barbara County. The purpose of the monitoring stations is to measure ambient concentrations of pollutants and determine whether the ambient air quality meets the CAAQS and the NAAQS. The nearest ambient monitoring stations to the proposed project site are the Lompoc South H Street and the Lompoc HS&P monitoring stations. The Lompoc South H Street station measures all criteria pollutants, but only commenced monitoring $PM_{2.5}$ in 2007. The only monitoring stations within Santa Barbara County that has monitored $PM_{2.5}$ for the period 2006 through 2008 are located on Broadway Street in Santa Maria and at 700 East Canon Perdido Street in Santa Barbara. Existing air quality conditions over the last 3 years are presented in Table 3-2.

The 1-hour CAAQS for ozone were not exceeded at the VAFB monitoring station during the period from 2004 through 2006 (most recent data available). The federal 8-hour ozone standard was not exceeded at the VAFB monitoring station during the period from 2004 through 2006. The federal PM_{10} standards were not exceeded at the VAFB monitoring station during the period from 2004 through 2006. The CAAQS for PM_{10}

Table 3-2. Existing air quality conditions (concentrations in ppm unless otherwise indicated).

Pollutant	Averaging Time	2006	2007	2008	CAAQS (ppm)	NAAQS[1] (ppm)	Monitoring Station
Ozone	8-hour	0.054	0.062	0.074	0.070	0.075	Lompoc S. H Street
	1-hour	0.056	0.078	0.082	0.09	-	Lompoc S. H Street
PM_{10}[2]	Annual Arithmetic Mean	17.2 µg/m^3	19.6 µg/m^3	20.9 µg/m^3	20 µg/m^3	-	Lompoc S. H Street
	24-hour	46.9 µg/m^3	37.8 µg/m^3	47.7 µg/m^3	50 µg/m^3	150 µg/m^3	Lompoc S. H Street
$PM_{2.5}$	Annual Arithmetic Mean	10.1 µg/m^3	9.5 µg/m^3	10.4 µg/m^3	12 µg/m^3	15 µg/m^3	Canon Perdido
	24-hour	27.9 µg/m^3	23.5 µg/m^3	44.2 µg/m^3	-	35 µg/m^3	Canon Perdido
NO_2	Annual	0.005	0.005	0.003	0.030	0.053	Lompoc S. H Street
	1-hour	0.037	0.037	0.037	0.18	0.100	Lompoc S. H Street
CO	8-hour	1.09	1.18	1.06	9.0	9	Lompoc S. H Street
	1-hour	2.3	4.6	2.1	20	35	Lompoc S. H Street
SO_2	Annual	0.000	0.000	0.000	-	0.030	Lompoc S. H Street
	24-hour	0.002	0.003	0.002	0.04	0.14	Lompoc S. H Street
	3-hour	0.003	0.005	0.003	-	0.5	Lompoc S. H Street
	1-hour	0.006	0.011	0.0047	0.25	-	Lompoc S. H Street

NOTES:

1. Secondary NAAQS
2. California averages reported for PM_{10}

SOURCE: www.arb.ca.gov (all pollutants except 1-hour CO and 1-hour and 3-hour SO_2 and annual data for 2005)
www.epa.gov/air/data/monvals.html (1-hour CO and 1-hour and 3-hour SO_2 and annual data for 2005)

was exceeded once during that period. The data from the monitoring stations indicate that air quality is in attainment of all other state and federal standards.

3.1.3 Federal Requirements

The U.S. EPA is the agency responsible for enforcing the Clean Air Act (CAA) of 1970 and its 1977 and 1990 amendments. The purpose of the CAA is to establish NAAQS, to classify areas as to their attainment status relative to the NAAQS, to develop schedules and strategies to meet the NAAQS, and to regulate emissions of criteria pollutants and air toxics to protect public health and welfare. Under the CAA, individual states are allowed to adopt ambient air quality standards and other regulations, provided they are at least as stringent as federal standards. The Clean Air Act Amendments (CAAA) of 1990 established new deadlines for achievement of the NAAQS, dependent upon the severity of non-attainment.

The U.S. EPA requires each state to prepare a State Implementation Plan (SIP), which describes how that state will achieve compliance with the NAAQS. A SIP is a compilation of goals, strategies, schedules, and enforcement actions that will lead the state into compliance with all federal air quality standards. Each change to a compliance schedule or plan must be incorporated into the SIP. In California, the SIP consists of separate elements for each air basin, depending on the attainment status of that air basin.

The CAAA also require that states develop an operating permit program that would require permits for all major sources of pollutants. The program would be designed to reduce mobile source emissions and control emissions of HAPs through establishing control technology guidelines for various classes of emission sources.

New Source Review. A New Source Review (NSR) is required when a source has the potential to emit any pollutant regulated under the CAA in amounts equal to or exceeding specified major source thresholds (100 or 250 tons per year) which are predicated on a source's industrial category. A major modification to the source also triggers an NSR. A major modification is a physical change or change in the method of operation at an existing major source that causes a significant "net emissions increase" at that source of any pollutant regulated under the CAA. Any new or modified stationary emission sources require permits from the SBCAPCD to construct and operate. Through the SBCAPCD's permitting processes, all stationary sources are reviewed and are subject to an NSR process. The NSR process ensures that factors such as the availability of emission offsets and their ability to reduce emissions are addressed.

Executive Order 12088. EO 12088, *Federal Compliance with Pollution Control Standards*, requires the head of each federal agency to comply with "applicable pollution control standards" defined as "the same substantive, procedural, and other requirements that would apply to a private person." The EO further requires federal agencies to cooperate with the U.S. EPA, state, and local environmental regulatory officials. To ensure their cost-effective and timely compliance with applicable pollution control standards, the U.S. EPA Administrator is required to provide technical advice and assistance to executive agencies. EO 12088 also provides that disputes between the U.S. EPA and other federal agencies, regarding environmental violations, shall be elevated to the Office of Management and Budget for resolution. EO 13432 revoked Section 1-4, *Pollution Control Plan*, of EO 12088.

Executive Order 13423. On January 24, 2007, President Bush issued EO 13423, *Strengthening Federal Environmental, Energy, and Transportation Management*. One of the main requirements established under this EO is the reduction of GHG through a reduction in energy intensity of 3 percent per year or 30 percent by the end of fiscal year 2015.

Executive Order 13432. This EO, entitled *Cooperation Among Agencies in Protecting*

the Environment with Respect to Greenhouse Gas Emissions from Motor Vehicles, Nonroad Vehicles, and Nonroad Engines, was issued to ensure that all necessary actions are taken to integrate environmental accountability in agency day-to-day decision making and long-term planning processes, across all agency missions, activities, and functions. Pollution prevention is highlighted as a key aspect to the environmental management system process. The head of each federal agency is responsible for ensuring that all necessary actions are taken to integrate environmental accountability into agency day-to-day decision making and long-term planning processes, across all agency missions, activities, and functions. Consequently, environmental management considerations must be a fundamental and integral component of federal government policies, operations, planning, and management. The head of each federal agency is responsible for meeting the goals and requirements of this order. Examples of environmental requirements include air, water, wastewater, or hazardous waste permits.

Executive Order 13514. This EO, *Federal Leadership in Environmental, Energy, and Economic Performance*, was signed by President Obama on October 5, 2009. EO 13514 defines three scopes of emissions, which include the following: (i) scope 1: direct GHG emissions from sources that are owned or controlled by the federal agency; (ii) scope 2: direct GHG emissions resulting from the generation of electricity, heat, or steam purchased by a federal agency; and (iii) scope 3: GHG emissions from sources not owned or directly controlled by a federal agency but related to agency activities such as vendor supply chains, delivery services, and employee travel and commuting.

General Conformity. Under 40 CFR Part 93 and the provisions of Part 51, Subchapter C., Chapter I, Title 40, Appendix W of the CFR, of the CAA as amended, federal agencies are required to demonstrate that federal actions conform with the applicable SIP. In order to ensure that federal activities do not hamper local efforts to control air pollution, Section 176(c) of the CAA, 42 U.S.C. 7506(c), prohibits federal agencies, departments, or instrumentalities from engaging in, supporting, providing financial assistance for, licensing, permitting, or approving any action which does not conform to an approved state or federal implementation plan. The provisions of Part 51, Subchapter C, Chapter I, Title 40, of the CFR, went in effect December 27, 1993.

The U.S. EPA general conformity rule applies to federal actions occurring in non-attainment or maintenance areas. Because Santa Barbara County is an unclassified/attainment area for all NAAQS, the General Conformity Rule does not apply to the Proposed Action at VAFB.

National Emissions for Hazardous Air Pollutants. Section 112(a) of the CAAA requires the development of emission standards for listed HAPs from new and modified equipment at stationary major and area sources (i.e., a source that is not a major HAP source). Emission standards promulgated under this subsection require the maximum degree of reduction in emissions of HAPs for specific source categories. The standards are to be established by taking into consideration the cost of achieving such emission reductions, and any non-air quality health and environmental impacts and energy requirements.

National Emissions for Hazardous Air Pollutants (NESHAP) regulations, codified at 40 CFR Parts 61 and 63, regulate HAP emissions. Part 61 was promulgated prior to the 1990 CAAA and regulates specific HAPs: asbestos, benzene, beryllium, coke oven emissions, inorganic arsenic, mercury, radionuclides, and vinyl chloride. The 1990 CAAA established an original list of 189 HAPs to be regulated, which resulted in the promulgation of Part 63, also known as the Maximum Achievable Control Technology (MACT) standards. These MACTs regulate emissions from major HAP sources and specific source categories that emit HAPs. VAFB is currently considered a minor or area

HAP source, and is therefore not subject to NESHAP regulations for major sources.

3.1.4 Local Requirements

As indicated previously, in Santa Barbara County, the SBCAPCD is the agency responsible for the administration of federal and state air quality laws, regulations, and policies. Included in the local air districts' tasks are monitoring of air pollution, maintenance of air quality standards through programs to control air pollutant emissions, and the promulgation of Rules and Regulations.

SBCAPCD regulations require that facilities building, altering, or replacing stationary equipment that may emit air pollutants, to obtain an Authority to Construct permit. Further, SBCAPCD regulations require stationary sources of air pollutants to obtain a Permit to Operate. The local air districts are responsible for the review of applications and for the approval and issuance of these permits. In addition, the SBCAPCD regulations require stationary sources that would emit 25 tons per year or more of any pollutant except CO in any calendar year during construction to obtain emission offsets. SBCAPCD's New Source Review Regulation established offset thresholds for operational emissions from new or modified stationary sources as follows (Rule 802):

- 55 pounds per day, or 10 tons per year, for nonattainment pollutants and precursors (i.e., reactive organic compounds or NOx).
- 80 pounds per day, or 15 tons per year, for PM_{10}; and
- 150 pounds per day, or 25 tons per year, for CO if in nonattainment.

Spark ignition engines that operate less than 200 hours per year are exempt from permitting by the SBCAPCD. Should spark ignition engines be used for the diesel generators, and should they operate less than 200 hours per year, they would not require permitting. Applicable SBCAPCD Rules and Regulations are as follows:

- Rule 201 – Permits Required
- Rule 204 – Applications
- Rule 302 – Visible Emissions

Rule 333 – Control of Emissions from Reciprocating Internal Combustion Engines (note that engines that operate less than 200 hours per year are exempt from permit requirements and the provisions of this rule, with the exception of the engine identification requirement in Section D.1, the elapsed operating time meter requirement in Section D.2, the recordkeeping provisions in Section J.3, and the compliance schedules for these provisions specified in Section K).

Should the facility conduct surface coating operations, employ solvents, and/or conduct abrasive blasting operations, the operations would be required to obtain an Authority to Construct and Permit to Operate from the SBCAPCD as required under Rule 201. These operations would also be subject to the following SBCAPCD Rules:

- Rule 321, Solvent Cleaning: This rule applies to solvent cleaners/degreasers such as remote reservoir solvent cleaners. This rule does not apply to use of wipe solvents for cleaning operations, use of solvents in spray gun cleaners, batch cleaners using chlorinated solvents, and cold solvent degreasers of 10 gallons or less in capacity.
- Rule 322, Metal Surface Coating Thinner and Reducer: This rule restricts the use of photochemically reactive organics in metal surface coating thinners and reducers.
- Rule 330, Surface Coating of Metal Parts and Products: This rule limits the amount of reactive organic compounds in metal parts and products coatings, and governs handling of surface coatings.
- Rule 337: Surface Coating of Aircraft or Aerospace Vehicle Parts and Products: This rule limits the amount of reactive organic compounds in aircraft or aerospace vehicle parts and products coatings, and governs handling of coatings.

There are no source-specific requirements for abrasive blasting.

3.1.5 Greenhouse Gases and Climate Change

Currently, the EPA has not listed standards for GHG emissions by which context and intensity can be measured for the purposes of defining a 'significant impact' under NEPA. On February 18, 2010, the CEQ released draft guidance on addressing climate change in NEPA documents (Sutley 2010). The draft guidance, which has been issued for public review and comment, recommends quantification of GHG emissions, and proposes a threshold of 25,000 metric tons of carbon dioxide equivalent (CO_2e) emissions. The CEQ indicates that use of 25,000 metric tons of CO_2e emissions as a reference point would provide federal agencies with a useful indicator, rather than an absolute standard of significance, to provide action-specific evaluation of GHG emissions and disclosure of potential impacts.

The California Natural Resources Agency recently adopted amendments to the California Environmental Quality Act (CEQA) guidelines to address global climate change impacts. According to Appendix G of the CEQA Guidelines, the following criteria are considered to establish a significance threshold for global climate change impacts:

- Would the project generate GHG emissions, either directly or indirectly, that may have a significant impact on the environment?
- Would the project conflict with an applicable plan, policy, or regulation adopted for the purpose of reducing the emissions of greenhouse gases?

As discussed in Section 15064.4 of the CEQA Regulations, the determination of the significance of GHG emissions calls for a careful judgment by the lead agency consistent with the provisions in section 15064. A lead agency should make a good-faith effort, based to the extent possible on scientific and factual data, to describe, calculate or estimate the amount of greenhouse gas emissions resulting from a project. A lead agency shall have discretion to determine, in the context of a particular project, whether to:

- Use a model or methodology to quantify greenhouse gas emissions resulting from a project, and which model or methodology to use. The lead agency has discretion to select the model or methodology it considers most appropriate provided it supports its decision with substantial evidence. The lead agency should explain the limitations of the particular model or methodology selected for use; and**/**or
- Rely on a qualitative analysis or performance based standards.

A lead agency should consider the following factors, among others, when assessing the significance of impacts from GHG emissions on the environment:

- The extent to which the project may increase or reduce GHG emissions as compared to the existing environmental setting;
- Whether the project emissions exceed a threshold of significance that the lead agency determines applies to the project.
- The extent to which the project complies with regulations or requirements adopted to implement a statewide, regional, or local plan for the reduction or mitigation of GHG emissions. Such requirements must be adopted by the relevant public agency through a public review process and must reduce or mitigate the project's incremental contribution of GHG emissions. If there is substantial evidence that the possible effects of a particular project are still cumulatively considerable notwithstanding compliance with the adopted regulations or requirements, an Environmental Impact Report must be prepared for the project.

Because the contribution to global climate change from construction emissions is short-term, the South Coast Air Quality Management District recommends amortizing

construction emissions over a 30-year period to evaluate their contribution to GHG emissions over the project's lifetime.

3.2 Biological Resources

Federal agencies are required under section 7 of the Endangered Species Act (ESA) of 1973, as amended (16 U.S.C. 1531 et seq.), to assess the effect of any project on federally listed threatened and endangered species. Under section 7, consultation with the U.S. Fish and Wildlife Service (USFWS) and the National Oceanic and Atmospheric Administration, National Marine Fisheries Service (NOAA Fisheries Service) is required for federal projects if such actions could directly or indirectly affect listed species (threatened, endangered, rare, or candidate) or destroy or adversely modify critical habitat. It is also Air Force policy to consider listed and special status species recognized by state agencies when evaluating the impacts of a project.

Biological resources on VAFB are abundant and diverse because the Base is within an ecological transition zone, where the northern and southern ranges of many species overlap, and because the majority of the land within its boundaries has remained undeveloped. Fourteen major vegetation types have been described and mapped on VAFB (VAFB *In Progress*), which provide habitat for many federal and state listed threatened, endangered, and special concern plant and animal species.

For the purposes of this resource assessment, the project area includes the entire SLC-4E complex, which includes SLC-4E itself, the associated administration buildings, and the parking areas to the northwest. The interior portion of SLC-4E is buffered by a 300-ft launch overpressure zone, which is also included in the project area. Impacts to special status species are also considered for all areas potentially over flown by the Falcon 9 and Falcon 9 Heavy vehicles, as well as special status species occurring in areas that may be impacted by launch noise in excess of 100 A-weighted decibels (dBA). Figure 3-1 depicts these areas. The 100 dBA threshold was chosen for disturbance based on studies completed by AMEC Americas Limited on the effects of noise on wildlife (AMEC Americas Limited 2005). Given that not many studies are available on this subject, this study was selected because it is comprehensive and studied the effect of aircraft noise on various wildlife, including birds. As the authors indicate in this study, responses are variable by species.

SpaceX recently completed ground acoustic levels modeling for the Falcon 9 and Falcon 9 Heavy (SpaceX 2010). For the Falcon 9 launch vehicle, sound pressure levels drop below 100 dBA at a horizontal distance of 5.3 miles from the launch site, and for the Falcon 9 Heavy at a horizontal distance of 7.4 miles from the launch site (Figure 3-1).

3.2.1 Methodology

A complete biological and special status species survey was conducted in March 2010 within the area that would be impacted by the proposed modifications to SLC-4E, including construction and landscape maintenance activities. This area included the interior of the SLC-4E complex as well as an area extending 30 ft from the outer perimeter fence. No physical impacts to vegetation or special status species habitats are expected beyond this point. Stands of seacliff buckwheat (*Eriogonum parvifolium*), host plant to the federally endangered El Segundo blue butterfly (*Euphilotes battoides allyni*), and vegetation types were mapped using orthographic photographs and a Trimble Geo XT GPS unit. Vertebrates occurring within this area were identified visually, acoustically and by sign.

Records and reports were also reviewed from prior surveys in the region to assess the potential occurrence of special status species not encountered during the March 2010 surveys, as well as within the 300-ft overpressure zone, the potential overflight

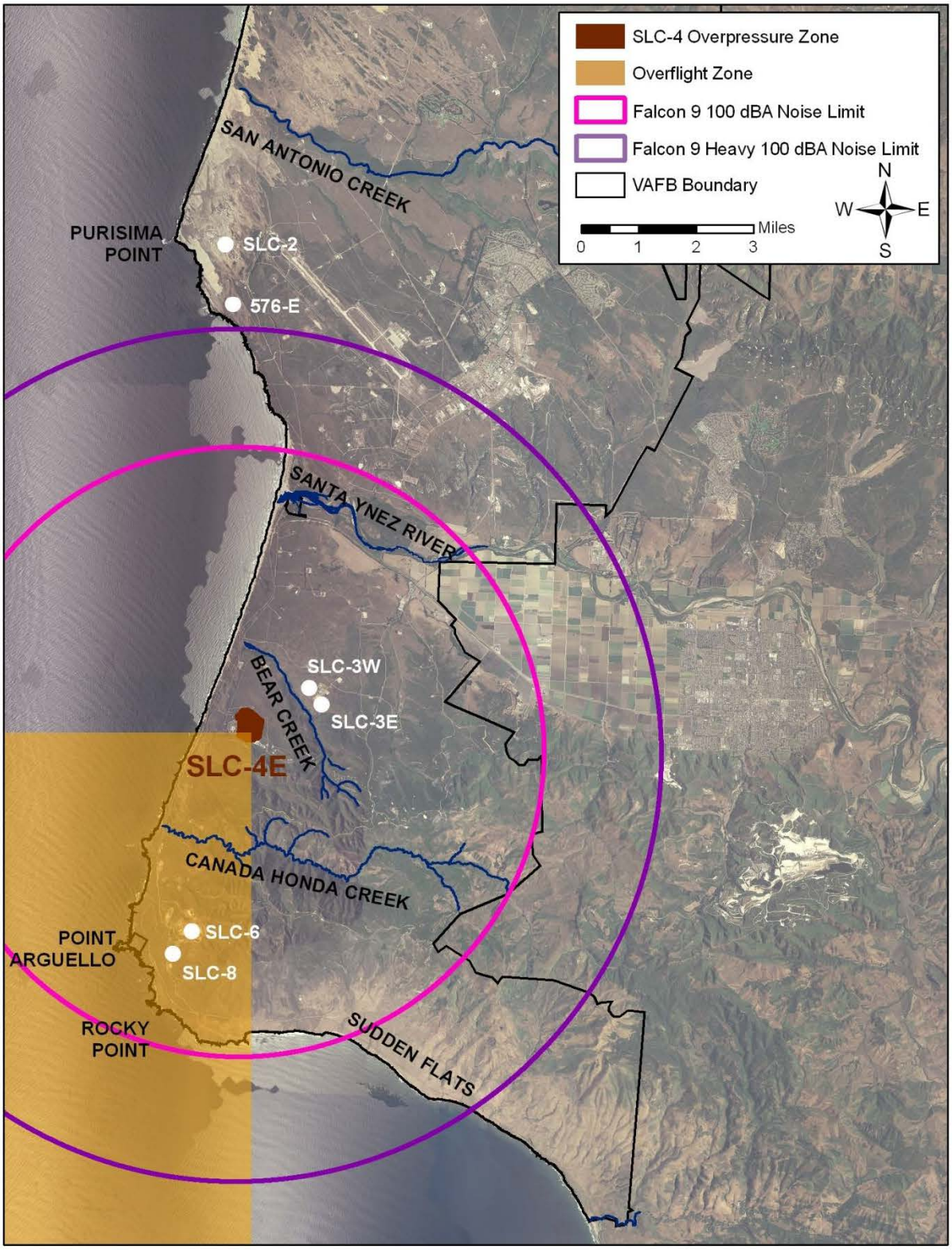

Figure 3-1. Areas considered for potential effects to biological resources.

zone, and areas likely to be affected by launch noise. Suitable habitat west of Coast Road, within the potential launch overflight area was surveyed for beach layia (*Layia carnosa*), a federally endangered species. Beach layia stands were mapped in the field with a Trimble Geo XT. A site check was also conducted within Spring Creek at potential water discharge sites to evaluate water levels and suitability of habitat for California red-legged frogs (*Rana draytonii*).

3.2.2 Vegetation Types within the SLC-4E Overpressure Zone

In addition to areas dominated by plant cover, there are approximately 32.1 acres covered by pavement and/or structures within the SLC-4E overpressure zone. An additional 0.8 acre is covered by unvegetated dirt access trails. Vegetation types are described in detail below. Where suitable, plant community nomenclature follows Holland (1986). Plant species nomenclature follows Hickman (1993). Table 3-3 provides acreages of each vegetation type within the proposed project area.

Table 3-3. Acreage of each vegetation type within the SLC-4E overpressure zone.

Vegetation Type	Acreage
Non-native Grassland	79.3
Central Coast Scrub	17.1
Central Coast Scrub/Non-native Grassland	9.1
Arroyo Willow Riparian Forest	2.1
Non-native Woodland	1.5

Non-native Grassland

This vegetation type occurs most commonly in areas that have been subjected to prior disturbance allowing weedy non-native species adapted to frequent disturbance to invade and dominate a site. Within SLC-4E, annual grasses (*Bromus* and *Avena* spp.), veldt grass (*Ehrharta calycina*), and iceplant (*Carpobrotus* spp.) dominate the non-native grassland (NNG). Seacliff buckwheat occurs sparsely within this vegetation type as well.

Central Coast Scrub

Central coast scrub (CCS) is characterized by shallow-rooted, mesophylic plant species that are often drought-deciduous and summer-dormant. Past disturbances have facilitated the establishment of many non-native species such as iceplant within this vegetation type. The dominant native species at this site are coyote brush (*Baccharis pilularis*), California sagebrush (*Artemisia californica*), mock heather (*Ericameria ericoides*), and black sage (*Salvia mellifera*). Portions of the CCS have been subjected to past disturbances, resulting in a mixed CCS/NNG vegetation type. Seacliff buckwheat is sparsely present within the CCS vegetation type.

Arroyo Willow Riparian Forest

Central Coast arroyo willow riparian forest (RIP) is a dense, low, closed-canopy, broad-leafed, winter-deciduous riparian forest dominated by arroyo willow (*Salix lasiolepis*), which can grow as a tree or treelike shrub. Within the overpressure zone, this vegetation type is restricted to Spring Canyon, where it grows in and along Spring Creek.

Non-native Woodland

Non-native woodland (NNW) within the overpressure zone is confined to the base of Spring Canyon where blue gum eucalyptus trees (*Eucalyptus globulus*) have displaced native riparian vegetation along the creek channel. In this area, eucalyptus form a dense monotypic stand with their thick litter layer limiting the growth of understory vegetation below the trees.

3.2.3 Wildlife Species

The vast majority of the area to be affected by landscape management practices at SLC-4E is dominated by NNG (57.9 acres), with CCS/NNG (1.8 acres) being the only other vegetation type present. Intact CCS, RIP, and NNW are present within the overpressure zone in addition to the aforementioned vegetation types. These vegetation types

provide habitat for a variety of vertebrate species.

Pacific treefrog (*Pseudacris regilla*) are likely to be the most common amphibian species within the project area; lungless salamanders such as the Monterey ensatina (*Ensatina eschscholtzii eschscholtzii*), and arboreal salamander (*Aneides lugubris*) would also be expected to occur.

Reptile species observed and expected within the overpressure zone include western fence lizard (*Sceloporus occidentalis*), southern alligator lizard (*Elgaria multicarinata*), western terrestrial gartersnake (*Thamnophis elegans terrestris*) and southern pacific rattlesnake (*Crotalus helleri*).

Birds commonly associated with vegetation types within the overpressure zone include house finch (*Carpodacus mexicanus*), black phoebe (*Sayornis nigricans*), and cliff swallow (*Petrochelidon pyrrhonota*), which were commonly observed during field surveys. Also observed were barn swallow (*Hirundo rustica*) and great-horned owl (*Bubo virginianus*). All of these species are likely to nest within SLC-4E, utilizing structures left derelict after the cessation of activities associated with the Titan IV launch program.

A variety of mammal species were also observed during field surveys or are expected to occur within the overpressure zone. These include brush rabbit (*Sylvilagus bachmani*), long-tailed weasel (*Mustela frenata*), coyote (*Canis latrans*), and black-tailed deer (*Odocoileus hemionus*). Small mammals include various species of mice (*Peromyscus* spp.), and valley pocket gopher (*Thomomys bottae*).

3.2.4 Special Status Species

Table 3-4 lists federal and state threatened and endangered species, and other special status species that occur or have the potential to occur within the project area and its vicinity. Several species were excluded from potential occurrence because they do not breed within the project area and their special status affords them protection only during their breeding period, or they do not occur in the form that affords them special status protection (i.e., rookeries or nesting colonies).

3.2.4.1 Federal ESA Listed Species

This EA considers species that may be affected by activities under the Proposed Action. Species unlikely to be affected by SLC-4E modifications, landscape maintenance, launch noise, and not present within the overpressure or overflight zones, were not given further consideration. This includes federally listed plant species such as the federally endangered Lompoc yerba santa (*Eriodictyon capitatum*), Gaviota tarplant (*Deinandra increscens* ssp. *villosa*) and Gambel's watercress (*Nasturtium gambellii*). Special status fish species such as the federally endangered southern steelhead (*Oncorhynchus mykiss*), and unarmored threespine stickleback (*Gasterosteus aculeatus williamsoni),* were also not considered due to their absence from the overflight zone, distance from SLC-4E, and the ability of water to attenuate sound. An introduced population of unarmored threespine stickleback occurred at one time within Honda Creek; however, surveys conducted by ManTech SRS Technologies Inc. (MSRS) in 2008 indicated that this population is no longer extant.

Beach Layia

Beach layia is a winter annual that germinates following fall and winter rains, flowers in spring and sets seed in summer. It reaches the northern limit of distribution in Humboldt County, and the southern limit of its distribution in Santa Barbara County on VAFB, where it grows as a member of the dune scrub vegetation type in sparsely vegetated areas, such as ridges and dune slumps opened up by erosion and sand movement. Stands have been documented west of Coast Road from Bear Creek Road south to Honda Ridge Road.

Suitable habitat for beach layia is not present within the SLC-4E complex or the 300-ft overpressure zone. Occupied beach layia

Table 3-4. Special status plant and wildlife species within the proposed project area.

Common Name *Scientific Name*	Status		Occurrence				Habitat	Comments
	USFWS/ NOAA[1]	CDFG[2]	SLC-4E interior	Over pressure	Over flight	100 dBA		
Beach layia *Layia carnosa*	FE				Documented	N/A	Open sandy coastal areas within dune scrub	Flowers March - June
El Segundo blue butterfly *Euphilotes battoides allyni*	FE		Potential	Potential	Potential	N/A	Occurrence is tied to its host plant: seacliff buckwheat	Adult flight period June – September
Tidewater goby *Eucyclogobius newberryi*	FE				Potential	N/A	Estuarine areas within the fresh and salt water interface	Active year round
California least tern *Sterna antillarum browni*	FE	SE, FP				Potential	Sand dunes near water	Spring migrant, breeds mid April – August
Western snowy plover *Charadrius alexandrinus nivosus*	FT, BCC	SSC			Documented	Documented	Coastal sandy beaches, dunes	Resident, breeds March - September
California red-legged frog *Rana draytonii*	FT	SSC		Potential	Documented	Documented	Chiefly associated with perennial ponds, streams	Active year round, breeds November – April
Southern sea otter *Enhydris lutris neris*	FT	SSC, FP			Documented	Documented	Coastal waters	Active year round
California brown pelican *Pelecanus occidentalis californicus*	FD	SD			Documented	Documented	Near-shore waters, coastal bluffs, rock outcrops	Migrant, most abundant June – January
Bald eagle *Haliaeetus leucocephalus*	BGEPA, FD	SE			Potential	Potential	Large lakes and wetlands	Rare winter migrant
American peregrine falcon *Falco peregrinus anatum*	FD, BCC	SD, FP	Potential	Potential	Documented	Documented	Nest on cliffs, forage over all open habitats	Resident, breeds mid-February - July
Golden eagle *Aquila chrysaetos*	BGEPA	FP	Potential	Potential	Documented	Documented	Forages over grasslands and open woodlands, nest in local mountains	Resident, breeds January - August
Pacific harbor seal *Phoca vitulina richardsi*	MMPA				Documented	Documented	Coastal rocks and isolated sandy beaches	Resident on VAFB, pups March - June
California sea lion *Zalophus californianus*	MMPA				Documented	Documented	Coastal rocks and isolated sandy beaches	Seasonal resident on VAFB, typically breeds in Northern Channel Islands
Northern elephant seals *Mirounga angustirostris*	MMPA				Documented	Documented	Isolated sandy beaches	Occasional on VAFB, breeds in Northern Channel Islands and mainland in Big Sur Piedras Blancas.
Northern fur seal *Callorhinus ursinus*	MMPA						Isolated sandy beaches	Breeds in Northern Channel Islands.
Mountain plover (wintering) *Charadrius montanus*	BCC	SSC				Documented	Semi-arid plains, grassland and plateaus	Winter migrant at VAFB Airfield
Black oystercatcher (nesting) *Haematopus bachmani*	BCC				Documented	Documented	Rock outcrops, coastal bluffs	Resident, breeds May - September

Common Name *Scientific Name*	Status		Occurrence				Habitat	Comments
	USFWS/ NOAA[1]	CDFG[2]	SLC-4E interior	Over pressure	Over flight	100 dBA		
Whimbrel *Numenius phaeopus*	BCC				Documented	Documented	Beaches and coastal dunes	Resident
Long-billed curlew *Numenius americanus*	BCC				Documented	Documented	Beaches and coastal dunes	Resident
Marbled godwit *Limosa fedoa*	BCC				Documented	Documented	Beaches and coastal dunes	Resident
Western burrowing owl *Athene cunicularia hypugea*	BCC	SSC	Potential		Potential	Documented	Open, dry grassland	Winter migrant, potential breeder
Allen's hummingbird (nesting) *Selasphorus sasin*	BCC		Potential	Potential	Potential	Documented	Forage within grasslands, shrublands and woodlands; nest in shrubs and trees	Spring migrant, breeds February - August
Nuttall's woodpecker (nesting) *Picoides nuttallii*	BCC			Potential	Documented	Documented	Forage and nest within woodland habitats	Resident, breeds March - August
Loggerhead shrike (nesting) *Lanius ludovicianus*	BCC	SSC		Potential	Potential	Documented	Forage over all open habitats; breed in shrubs or trees	Resident, breeds March - August
Oak titmouse (nesting) *Baeolophus inornatus*	BCC				Potential	Documented	Forage and nest in oak woodland	Resident, breeds March - August
Yellow warbler (nesting) *Dendroica petechia brewsteri*	BCC			Potential	Potential	Documented	Forage and nest in riparian woodlands	Spring migrant, breeds March - August
Tricolored blackbird (nesting colony) *Agelaius tricolor*	BCC	SSC				Documented	Forage in grasslands and agricultural fields; nest in densely vegetated wetlands	Resident, breeds March - August
Lawrence's goldfinch (nesting) *Carduelis lawrencei*	BCC		Potential	Potential	Potential	Documented	Open woodlands, scrublands and weedy fields.	Resident, breeds March - August

Notes:
N/A = Not Applicable
1 FE = Federal Endangered Species FT = Federal Threatened Species FD = Federally Delisted Species BCC = Federal Bird of Conservation Concern BGEPA = Bald and Golden Eagle Protection Act MMPA = Marine Mammal Protection Act
2 CDFG = California Department of Fish and Game; SE = California Endangered Species SD = State Delisted Species SSC = California Species of Special Concern FP = California Fully protected Species

habitat within the overflight zone totals 11.4 ft^2.

Critical habitat has not been designated for this species; thus, the proposed project would not affect critical habitat.

El Segundo Blue Butterfly

The federally endangered El Segundo blue butterfly (ESBB) occurs in coastal dune scrub, along coastal bluffs and in CCS. The adult flight period (June-September) coincides with the blooming period of its host plant, seacliff buckwheat (Arnold 1978, 1983; Pratt and Ballmer 1993). Eggs are deposited on buckwheat flowers and buds where the larvae feed until maturation. Upon maturation larvae burrow into the soil and pupate, usually within the root and debris zone of the host plant (Mattoni 1992; Pratt and Ballmer, pers. obs.). Pupae remain in diapause until at least the following flight season. The number of adult butterflies that emerge in a given year is dependent on environmental conditions. The majority of the pupae may remain in diapauses if environmental conditions are not favorable (Pratt and Ballmer 1993).

A total of 139 seacliff buckwheat plants were identified during 2010 surveys within the SLC-4E complex. Widely scattered buckwheat is also present at low densities within the CCS in the overpressure zone. The March 2010 surveys were outside of the June to early September flight period when adult ESBB may be active. Potential for ESBB to occur on site is based on the occurrence of their host plant, seacliff buckwheat, within the project area. Flight season surveys conducted in July 2009, 0.28 mile west of the overpressure zone, did not document ESBB. Based on ESBB surveys conducted to date, the overpressure zone is approximately 1.16 miles from the nearest documented occurrence of ESBB on VAFB (MSRS 2010b). This locality represents an isolated individual observed at Bear Creek and Coast Roads in 2008. Subsequent surveys in the area conducted in both 2008 and 2009 failed to document additional ESBB (MSRS 2010b). ESBB have also never been documented in the overflight zone.

Critical habitat was proposed for this species in 1977 (42 FR 7972-7976), but has not yet been designated. Thus, the proposed project is not in critical habitat.

Tidewater Goby

Tidewater gobies are an estuarine fish typically inhabiting areas within the fresh and salt water interface. Dispersal and colonization of new sites occurs when individuals are flushed out to sea as a result of floods or high flows. These individuals may then travel along the coast, enter and colonize suitable estuarine habitat.

The nearest potential habitat is in Cañada Honda Creek, 2.6 miles southwest of the overpressure zone, within the overflight zone. Colonization of this creek by gobies was documented in 1995 (Swift et al 1997). The species was again documented in 2001 (K. Lafferty, pers. comm.; C. Swift, pers. comm.). Gobies were not present at this site in 2008 (MSRS 2009f) and the lagoon dried in the summer of 2009. During 2010 field surveys, the lagoon had refilled and was open to the ocean, making recolonization of the site possible. The nearest known occupied habitat is the Santa Ynez River, 3.5 miles north of the overpressure zone and outside of the overflight zone.

The USFWS designated critical habitat for this species in January 2008 (73 FR 5920-6006). VAFB was excluded from this designation under section 4(b)(2) of the ESA. Thus, the proposed project is not in critical habitat.

California Least Tern

Historically, California least terns (CLTE) nested in colonies in several locations along the coastal strand of the north VAFB coastline. Since 1998, with the exception of two nests established south of San Antonio Creek in 2002, least terns have nested only at the primary colony site, in relatively undisturbed bluff-top open dune habitat at Purisima Point, which is outside the overpressure and overflight zones, and

outside the 100 dBA noise zone. VAFB supports a very small percentage of California's breeding population of least terns. However, as one of only three known breeding colonies between Monterey and Point Conception, the population on VAFB remains significant.

Although it does not represent suitable nesting habitat, CLTE use the Santa Ynez River estuary as a foraging site. This site is 3.7 miles north of the overpressure zone and falls within the area that may be impacted by launch noise in excess of 100 dBA.

Critical habitat for this species has not been designated. As a result, the proposed projects would not affect critical habitat for the CLTE.

Western Snowy Plover

VAFB provides important nesting and wintering habitat for the western snowy plover (WSPL). WSPL habitat on VAFB includes all sandy beaches and adjacent coastal dunes from the rocky headlands at the north end of Minuteman Beach to the pocket beaches and dune areas adjacent to Purisima Point on north VAFB (approximately 7.7 miles). Also included are all sandy beaches and adjacent coastal dunes from the rocky headlands at the north end of Wall Beach, south to the rock cliffs at the south end of Surf Beach on south VAFB (approximately 4.8 miles). VAFB has consistently supported one of the largest populations of breeding WSPL along the west coast of the United States (Page and Persons 1995).

WSPL nest along the coast northwest of SLC-4E. The nearest record of an established WSPL nest is approximately 0.6 mile northwest of the overpressure zone. WSPL habitat is not present within the overpressure or overflight zones. However, all WSPL nesting habitat on south VAFB falls within areas that may be impacted by launch noise in excess of 100 dBA.

The USFWS designated critical habitat for this species in 1999 and revised this designation on September 29, 2005 (70 FR 56969-57119). VAFB was excluded from critical habitat designation under section 4(b)(2) of the ESA. Thus, the proposed project is not in critical habitat.

California Red-legged Frog

This highly aquatic federally threatened amphibian inhabits quiet pools of streams, marshes, and occasionally ponds, where it prefers shorelines with extensive vegetation. It is active year-round in coastal areas, and can be found in upland areas during the winter and early spring. Breeding can take place from November through April with most egg deposition occurring in March. California red-legged frogs (CRLF) have been documented traveling distances of over 1 mile during the wet season, and spending considerable time in riparian vegetation, out of water. It is believed that riparian vegetation provides good foraging habitat as well as good dispersal corridors due to canopy cover, and presence of moisture (USFWS 2002b).

CRLF were not observed during field surveys. The overpressure zone is just over 1 mile south of the nearest documented CRLF locality and breeding habitat in the Bear Creek lagoon (SRS Technologies 2001b). Bear Creek is not within the overflight zone. Within the overflight zone, CRLF have been documented within Cañada Honda Creek and in the vicinity of SLC-6, 2.6 and 3.6 miles southwest from SLC-4E, respectively.

Critical habitat was designated for this species in 2010 (75 FR 12815-12959). VAFB was excluded from the designation under section 4(a)(2) of the ESA. Thus, the proposed project is not in critical habitat.

Southern Sea Otter

Southern sea otters occur regularly off the coast of VAFB with animals typically concentrated in the kelp beds off of Purisima Point on north VAFB, and off of Sudden Flats on south VAFB. Both of these locations are outside of the overpressure and overflight zones, but the rafting area off of Sudden Flats may be impacted by launch noise in excess of 100 dBA.

Surveys conducted in 2006, as a monitoring requirement for a Delta IV launch from SLC-6, documented the presence of up to 55 adults in the nearshore waters off of the Sudden Flats area of south VAFB (SRS Technologies 2006g).

Critical habitat for this species has not been designated. As a result, the proposed project would not affect critical habitat for the sea otter.

3.2.4.2 Species Protected Under the Marine Mammal Protection Act

Under the Marine Mammal Protection Act (MMPA) of 1972, the 30 SW at VAFB was issued a 5-year permit for unintentional take of small numbers of marine mammals incidental to space vehicle and test flight activities (NOAA Fisheries Service 2009), hereafter referred to as the 5-year Permit, and a 1-year Letter of Authorization (NOAA Fisheries Service 2010), hereafter referred to as the LOA. Falcon vehicles were included under the 5-year Permit. The LOA allows specified launch programs to unintentionally take small numbers of marine mammals during launches. VAFB is required to comply with the conditions listed in this LOA and address NOAA Fisheries Service concerns regarding marine mammals at VAFB and the Northern Channel Islands (NCI). The LOA includes activities conducted pursuant to the SpaceX Falcon program.

Sonic booms caused by launches from VAFB have the potential to impact the NCI, including San Miguel, Santa Rosa, and Santa Cruz islands, located to the southeast of VAFB. The Point Bennett area of San Miguel Island (SMI) is one of the most important pinniped areas on the west coast of the United States. On SMI, the species of pinnipeds commonly found include California sea lions (*Zalophus californianus*), northern elephant seals (*Mirounga angustirostris*), northern fur seals (*Callorhinus ursinus*), and Pacific harbor seals (*Phoca vitulina richardsi*). Guadalupe fur seals (*Arctocephalus townsendi*) and Steller sea lions (*Eumetopias jubatus*) have bred in the past on SMI, but sightings have been rare since the mid-1980s (Forney et al. 2000).

Pacific Harbor Seal

Harbor seals congregate on various rocky haul out sites along the coast of VAFB. The highest concentrations are found on the rocky shoreline between the Boat House and South Rocky Point. Most of the pupping that occurs on VAFB also occurs at these sites. These haul outs are approximately 5.1 miles from the overpressure zone, are within the overflight zone, and may experience launch noise in excess of 100 dBA.

In addition, Pacific harbor seals reside and pup on the north and east ends of SMI. SMI is within the area that may be impacted by sonic booms from Falcon 9 vehicles launched from SLC-4E, as further discussed in Section 4.5.1.2 under Noise.

California Sea Lion

California sea lions haul out sporadically on rocks and beaches along the VAFB coast line. Sea lions may haul out within the overflight zone and/or areas that may experience launch noise in excess of 100 dBA. Sea lions rarely pup on VAFB. When pupping does occur, it is usually in conjunction with an El Niño event, with only stillborn or short-lived pups produced.

Sea lions, however, pup in large numbers on SMI. The main rookeries are found at Point Bennett, on the west end of the island, although sea lions also breed on the east end at Cardwell Point. There are approximately 23,000 California sea lion pups born on SMI each year (S. Melin, NOAA Fisheries Service/National Marine Mammal Laboratory, pers. comm.). As previously described, SMI is within the area that may be impacted by sonic booms from Falcon 9 vehicles launched from SLC-4E.

Northern Elephant Seal

Northern elephant seals haul out sporadically on rocks and beaches along the VAFB coast line. Elephant seals may haul out within the overflight zone and/or areas that may experience launch noise in excess of

100 dBA. Elephant seals do not breed on VAFB.

Elephant seals breed and pup in large numbers on SMI. The main rookeries are found at Point Bennett, on the west end of the island, but elephant seals also breed and pup on the east end at Cardwell Point. Over 10,000 elephant seal pups (Lowry 2002) may be born annually on SMI. As previously described, SMI is within the area that may be impacted by sonic booms from Falcon 9 vehicles launched from SLC-4E.

Northern Fur Seal

Northern fur seals are not found on VAFB, but do occur and breed on SMI. Fur seals pup at Point Bennett on the west end of the island. Several hundred northern fur seals pups (Forney et al. 2000) are born on SMI each year. As previously described, SMI is within the area that may be impacted by sonic booms from Falcon 9 vehicles launched from SLC-4E.

3.2.4.3 Other Special Status Species

A number of special status bird species, including the federal and state delisted California brown pelican (*Pelecanus occidentalis californicus*), and American peregrine falcon (*Falco peregrinus anatum*), and the federal delisted and state endangered bald eagle (*Haliaeetus leucocephalus*), have the potential to occur in the overpressure zone, overflight zone and/or in areas potentially experiencing noise levels in excess of 100 dBA. Table 3-4 lists status information and expected occurrence of these species within the project area. While some species may occur throughout the project area using it as foraging and/or breeding habitat, others may be rare transients.

3.2.5 Waters of the United States and Wetlands

For the wetland hydrology criterion to be met a site must be inundated or saturated or exhibit features that show the area was inundated or saturated for the required period of time (i.e., 45 days). Waters of the U.S. encompass navigable waters bound by the ordinary high water mark and adjacent wetlands and relatively permanent tributaries. No wetlands or Waters of the United States are present within areas affected by modification of SLC-4E or landscape maintenance activities associated with the Proposed Action.

3.3 Cultural Resources

Section 106 of the National Historic Preservation Act (NHPA) requires federal agencies to assess potential project related effects to historic properties that are listed or eligible for listing in the National Register of Historic Places (NRHP). Associated implementing regulations include 36 CFR 800, *Protection of Historic Properties*.

3.3.1 Archaeological Resources in the Vicinity

An archaeological site record and literature search was completed for the proposed project at the 30th Civil Engineer Squadron, Asset Management Flight, Environmental Conservation (30 CES/CEANC) Cultural Resources office at VAFB and at the Central Coast Information Center, University of California Santa Barbara (UCSB). Background research included a review of archaeological literature, archaeological base maps, and cultural resource records.

Previous studies

Previous archaeological studies and archaeological resources within 0.25 mile of SLC-4E were identified during the record search. Data sources examined at 30 CES/CEANC included the VAFB C-1 map series (46 map set), the Base Comprehensive Planning geographic information system (GIS), United States Geological Survey (USGS) topographic maps, and photogrammetric maps created of the SLC-4 area in 1958 (just prior to construction of SLC-4).

In the mid-1990s, the Tri-Services Cultural Resources Research Center at the United States Army Construction Engineering Research Laboratory (USACERL) completed a three-phase inventory and evaluation of Cold War properties on VAFB to assist the installation in its effort to comply with Section 106 of the NHPA (Nowlan et al. 1996, Nowlan and McCullough 1997, McCullough and Nowlan 1997). That effort culminated in a *Historic Preservation Plan for the Management and Treatment of Cold War Properties at Vandenberg Air Force Base, California* (HPP) that was part of the *Programmatic Agreement between Vandenberg Air Force Base, California and the California State Historic Preservation Officer Regarding the Management of Exceptionally Important Cold War Historic Properties under the Jurisdiction of Vandenberg Air Force Base, California.* The USACERL documents, the Programmatic Agreement, and the HPP were also consulted during the background research.

Table 3-5 lists previous cultural resources studies identified within 0.25 mile of SLC-4E. Most of the listed studies occurred outside of the SLC-4 complex; only a small part of the launch complex itself has been surveyed for archaeological resources. Previous surveys within SLC-4E have all been linear and include: one for a security clear zone (Stone and Haley 1981); one for a fiber-optic cable project (Environmental Solutions 1989);

Table 3-5. Previous archaeological studies within 0.25 mile of SLC-4E.

Author	VAFB No.	Report Title
Glassow et al. (1976)	1976-01	*Evaluation of Archaeological Sites on Vandenberg Air Force Base, Santa Barbara County, California*
Stone and Haley (1981)	1981-06	*Cultural Resources Evaluation of the Vandenberg Air Force Base Security Clear Zones, Santa Barbara County, California*
Neff (1982)	1982-05	*Vandenberg Air Force Base, California, 1982 Fuels Management Program Cultural Resources Survey/Evaluation*
Schilz et al. (1984)	1984-02	*Vandenberg Air Force Base, California, 1983 Fuels Management Program Project, Phase II, Cultural Resources Survey-Evaluation*
Schilz (1985)	1985-03	*Archaeological Survey, Testing, and Evaluation: STS Power Plant No. 6 Natural Gas Pipeline, Vandenberg Air Force Base, Santa Barbara County, California.*
Moore et al. (1988)	1988-05	*The Testing and Evaluation of Fourteen Archaeological Sites on South Vandenberg Air Force Base, Santa Barbara County, California*
Environmental Solutions (1989)	1989-07	*Phase One Archaeological Surface Inventory Report: Space Launch Complex 4 Fiber-Optic Cable Project, South Vandenberg Air Force Base, California*
Berry (1989)	1989-09	*Power Control Line Surface Survey: Resynchronization of Substation "K"*
Bergin (1989)	1989-12	*The Survey and Inventory of Archaeological Properties for the Backbone Fiber-Optic Transmission System Project, Vandenberg Air Force Base, Santa Barbara County, California*
Environmental Solutions (1990)	1990-06	*Space Transportation System Natural Gas Pipeline and SLC-4 Security Fence Treatment Programs, Vandenberg Air Force Base, Santa Barbara County, California*
Schmidt and Bergin (1990)	1990-18	*The Testing and Evaluation of Five Archaeological Sites for the Space Launch Complex 4 Power System Upgrade Project, Vandenberg Air Force Base, Santa Barbara County, California*
Snethkamp (1991)	1991-09	*Results of Phase 1 Archaeological Survey in Conjunction with SLC-3 East Modification Project, South Vandenberg Air Force Base, Santa Barbara County, California.*
Lebow et al. (2005)	2005-13	*Archaeological Investigations Supporting Consultation with the State Historic Preservation Officer for the Heritage Launch Program Demolition on Vandenberg Air Force Base in Santa Barbara County, California*

another for a fiber-optic cable project (Bergin 1989); and one for a power line (Berry 1989). In addition, archaeological excavations have been completed at CA-SBA-537/1816. The site is partially within SLC-4E, as described below, and excavations were completed within SLC-4E.

Because much of SLC-4E had not previously been surveyed for archaeological resources, a light detection and ranging (LIDAR) image of SLC-4E was closely examined to look for unmodified landforms. LIDAR penetrates through buildings and vegetation and can be used to map the underlying ground surface. Contours at 2-ft intervals generated from the LIDAR data were compared with a topographic map prepared by the Department of the Navy in 1958. That map was created prior to construction of SLC-4 using aerial photogrammetry with contours at 2-ft intervals. Proposed locations of missile launch facilities shown on the 1958 map precisely match the current locations of SLC-4E and SLC-4W (Lebow 2010).

The LIDAR image and comparison with the 1958 map revealed that most of the native landform within SLC-4E has been extensively modified. The only sizeable portion that appeared to be relatively unaltered was surveyed by Applied EarthWorks as part of the Section 106 compliance effort for the proposed project (Lebow 2010). No previously unknown archaeological resources were identified during that survey.

3.3.2 Recorded Cultural Resources

Seven archaeological sites and one isolated artifact are recorded within 0.25 mile of SLC-4E. These include CA-SBA-537, -1127, -1815, -1816, -1940, -2305, -2427, and VAFB-ISO-300. Of those, only CA-SBA-537 and VAFB-ISO-300 are within or partially within SLC-4E. CA-SBA-1816, while recorded as a separate site, is within CA-SBA-537 and forms a complex designated as CA-SBA-537/1816. Only a very small portion of the site complex extends into SLC-4E. Cultural resources within and adjacent to the proposed project area are described below.

CA-SBA-537/1816

CA-SBA-537 was originally recorded by Spanne in 1971, when it was considered a sparse scatter of marine shell and lithic debitage. The site was examined again during studies for the Space Transportation System (STS), and was characterized as a limited activity site that had been extensively damaged by firebreaks (Glassow et al. 1976). Subsequently, WESTEC Services, Inc., examined the site during a study for the STS Power Plant No. 6 natural gas pipeline, and found the portion of the site within the natural gas corridor so extensively disturbed that no additional studies were recommended (Schilz 1985:16).

Three studies have been completed at the site in conjunction with repairs or upgrades to SLC-4. The first of these was by Harmsworth Associates to support repair and restoration work at the launch complex, including installation of a new security fence (Moore et al. 1988). Most of this restoration work was necessary after a Titan 34D missile launch failed and destroyed portions of the launch facility. The initial testing effort included 45 1 by 1 m excavation units and 92 shovel test pits; the total excavated volume was 56.7 cubic meters (m^3). Altogether, excavations yielded 7,525 flakes, five cores, nine early stage bifaces, six finished bifaces (including four projectile points), 18 utilized flakes, 38 utilized flake knives, five cores, one abrader, one hammerstone, two punches, 56.8 grams of marine shell (primarily California mussel), and 632 kilograms (kgs) of bone (primarily large mammal).

Three artifact concentrations in CA-SBA-537 were identified (Moore et al. 1988). Locus A is in the westernmost part of the site, adjacent to the modern dunes and outside SLC-4. It was sampled with six excavation units, which revealed that the cultural assemblage in this part of the site was composed almost exclusively of marine shell. Radiocarbon analysis of two shell samples yielded uncorrected radiocarbon dates of 570 ± 80

before present (B.P.) and 500 ± 90 B.P. Locus B is just to the east of Locus A, on a small terrace truncated by the previous SLC-4 security fence. This part of the site was sampled with 10 excavation units, revealing the densest archaeological deposit. It was interpreted as a campsite where intensive biface reduction took place. Recovered artifacts included early and middle stage bifaces, ground stone, flake tools, fire-altered rock, cores, a tarring pebble, and an abrader. Almost no marine shell was recovered. Locus C is to the east, and was in the path of a proposed SLC-4 security fence. Three excavation units and a number of shovel test pits in this locus revealed that this part of the site contained a low-density deposit of flakes previously affected by slope terracing. Moore et al. (1988:7-4) also noticed "a number of small concentrations of cultural material" east of Locus C. Twenty excavation units in this eastern area recovered pockets of bone, shell, and lithic debitage that had been substantially affected by construction.

CA-SBA-1816 is composed of two artifact concentrations, identified as Loci A and B. Although contiguous with CA-SBA-537, CA-SBA-1816 was treated as a separate site and tested with seven 1 by 1 meter (m) excavation units, 49 shovel test pits, and five auger borings. The total excavated volume was 15.3 m^3 (Moore et al. 1988). Radiocarbon analysis of Locus A returned uncorrected radiocarbon ages of 420 ± 70 B.P and 430 ± 60 B.P. Six samples from Locus B yielded uncorrected dates ranging between 520 ± 80 and 1040 ± 70 B.P. Investigations in Locus A included one excavation unit and eight shovel test pits that yielded 177 flakes, one ground stone implement, two utilized flakes, one punch/scraper, 920.8 grams of marine shell, and 152 kgs of bone (primarily deer). The effort in Locus B was more substantial; six excavation units in this area yielded 1,095 flakes, seven ground stone tools, two biface/preforms, one projectile point, 16 possible utilized flakes, five tarring pebbles, 5,792.5 grams of fire-altered rock, 36,900 grams of marine shell, and 460 kgs of bone (primarily deer). Locus B was the only part of the CA-SBA-537/1816 complex to yield substantial amounts of fish bone.

Based on the testing results, CA-SBA-537 was interpreted as a resource processing site and CA-SBA-1816 as a short-term residence/resource processing site (Moore et al. 1988). Both were found to contain data important to understanding prehistory and were considered eligible for the NRHP. CA-SBA-537 was officially determined eligible for the NRHP by the Air Force in consultation with the California State Historic Preservation Officer (SHPO) in June of 1987; CA-SBA-1816 was determined eligible in August of 1988. The proposed security fence was redesigned to minimize adverse effects to cultural resources, but CA-SBA-537/1816 could not be entirely avoided.

Because installation of the security fence would adversely affect the CA-SBA-537/1816 site complex, a plan was developed to mitigate the effects through data recovery excavations (Environmental Solutions et al. 1988). The plan called for an initial phase to include excavation of 25 0.5 by 1.0 m units spaced along the 500 m of security fence through the sites, to assess inter- and intrasite variability. In the second phase of work, an additional 60 units were to be excavated, with unit placement based on the results of the first phase. For CA-SBA-1816, the strategy was to excavate 20 to 30 column samples (25 by 25 centimeter [cm] each).

Environmental Solutions (1990) implemented the treatment plan using the two-phase approach focused on impact areas associated with installation of the security fence. Their work primarily centered on Locus D at CA-SBA-537 (which they defined as the area east of the other three loci) and Locus B at CA-SBA-1816. As indicated by the treatment plan, the first phase used 25 excavation units and the second phase included 60 excavation units. Two 2 by 2 m units also were excavated. Altogether, excavated volume during implementation of the treatment plan in CA-SBA-537 was 91 m^3; an additional 8 m^3 was excavated in CA-SBA-1816. All

sediments were screened through 1/16-inch mesh.

Data recovery excavations at CA-SBA-537 yielded 1,918 bones (122.57 grams); identified taxa included mule deer, jackrabbit, cottontail or brush rabbit, ground squirrel, pocket gopher, and other small mammals. Marine shell, with a total weight of 63.23 grams, was primarily California mussel. Lithic artifacts included two ground stone implements, four bifaces, 11 blanks, two retouched scrapers, seven utilized flakes, and two utilized knives. CA-SBA-1816 yielded 19,641 bones (484.4 grams); identified taxa included mule deer, sea otter, weasel, jackrabbit, cottontail or brush rabbit, and various small mammals. Approximately 10,838 grams of marine shell were recovered, an assemblage dominated by California mussel (Environmental Solutions 1990).

Excavation results indicated that CA-SBA-1816 served as a camp, perhaps established to take advantage of seeds and bulbs between March and July. From the camp, people fished and collected shellfish along the coast and hunted game on Lompoc Mesa. CA-SBA-537 is composed of a series of small campsites; if occupied contemporaneously, they could represent individual households living separately. Technological analysis indicates that occupants at both sites were using locally available toolstone to manufacture bifaces, primarily using direct percussion. Tool assemblages are dominated by utilized flakes, as large biface flakes were used as cutting and scraping tools. Little change was observed in lithic technology throughout sites on the Lompoc Mesa. Occupants at both sites were primarily hunting and consuming deer and rabbits; shellfish played a secondary subsistence role.

The final project associated with SLC-4 repair and restoration was for a power system upgrade (Schmidt and Bergin 1990). Specifically, two utility poles and associated guyline anchors were to be placed in the portion of CA-SBA-537 west of Old Surf Road. Archaeological studies included excavation of five shovel test pits and three test excavation units of various sizes to determine if the site's significant qualities would be affected by installation of the utility poles. Sediments were screened through either 1/16- or 1/4-inch mesh. Two of the test excavation units found small amounts of deeply buried marine shell (a total of 1.28 grams), suggesting that the site boundary may extend west under the modern dunes. Eight flakes were recovered, but these were from the upper sediments in disturbed contexts. Also recovered was 3.15 grams of bone, but 98 percent of the total was considered intrusive. Due to the extremely low density of cultural materials associated with intact deposits, installation of the utility poles was not considered an adverse effect to the site's significant qualities.

In 2004, Applied EarthWorks tested in the vicinity of CA-SBA-537/1816 to determine whether demolition of selected facilities at SLC-4 would adversely affect the site's significant qualities (Lebow et al. 2005). That effort included 25 shovel test pits and a single 1 by 1 m unit, with selected shovel test pits excavated specifically to define the site boundary within SLC-4. Altogether, Applied EarthWorks' excavations within the space launch complex yielded only 72 pieces of lithic debitage, and no other cultural materials. Given the sparse archaeological deposit, the extensive disturbance, and the massive amount of previously completed archaeological excavations, Lebow et al. (2005:6.22–6.23) recommended that demolition would not adversely affect either site's significant qualities. 30 CES/CEANC subsequently made that determination and the California SHPO concurred.

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The VAFB GIS indicates that an isolated artifact was recorded in SLC-4E. It is unknown when the artifact was recorded or who recorded it. The artifact is described as "A thin biface midsection composed of green Franciscan chert" (Denardo and Lebow

2000). The plotted location of the artifact in the VAFB GIS is approximate.

SLC-4

Construction of SLC-4 began in 1961. Initially, the two launch pads (SLC-4E and SLC-4W) were designed to launch Atlas/Agena vehicles. The first launch occurred on July 12, 1963. Over time, the pads were modified to accommodate various Titan launch vehicles. SLC-4 has played an important role in the U.S. military space program, with many launches of classified reconnaissance satellite systems (Nowlan et al. 1996:109–111). Because they played a pivotal role during the Cold War, both SLC-4E and SLC-4W were recommended eligible for the NRHP under Cold War Criterion A (Nowlan et al. 1996:142). However, VAFB, in consultation with the SHPO, subsequently determined that SLC-4 was not eligible for the NRHP.

3.4 Hazardous Materials and Waste Management

Hazardous materials and wastes are those substances defined as hazardous by the Comprehensive Environmental Response, Compensation, and Liability Act, as amended by the Superfund Amendments and Reauthorization Act (42 U.S.C. 9601-9675); the Toxic Substances Control Act (15 U.S.C. 2601-2671); the Solid Waste Disposal Act, as amended by the Resource Conservation and Recovery Act (RCRA; 42 U.S.C. 6901-6992); and as defined in the State of California corresponding laws and regulations. In addition, federal and state OSHA regulations govern protection of personnel in the workplace. In general, the definitions within the citations include substances that, because of their quantity, concentration, or physical, chemical, or infectious characteristics, may present substantial danger to public health and welfare, to workers, or to the environment.

3.4.1 Hazardous Materials Management

VAFB uses approximately 5,000 hazardous materials items to accomplish its mission and mission support activities. The hazard potential of the materials used range across the spectrum of toxicity. Management of hazardous materials used on VAFB follows procedures found in 30th Space Wing Plan (SWP) 32-7086, *Hazardous Materials Management Plan*. The Base Hazardous Materials Pharmacy (HazMart) maintains inventories of hazardous materials, whether purchased by the Air Force or its contractors. Before releasing hazardous materials to the user, HazMart staff ensures a copy of the Material Safety Data Sheet is available and verifies that the material is suitable for use on VAFB. By providing handling and use information, VAFB controls the potential misuse of hazardous materials, maintains an accounting of the types of hazardous materials used on Base, and accomplishes usage and emissions reports as required by federal, state, and local laws and regulations.

Hazardous materials used during construction activities include petroleum, oil, and lubricants (POLs) in construction equipment and vehicles. Gas, fuel, oil, and solvents would be used during launch operations, as described in Chapter 2.

VAFB requires all contractors and commercial entities using hazardous materials on Base to submit a Hazardous Material Contingency Plan. Hypergolic propellants used at VAFB are controlled by United Paradyne, which handles the purchase, transport, storage and loading of hypergolic fuels and oxidizers. All hypergolics are stored at the Hypergolic Fuels Storage Facility (Buildings 974 and 975) on south VAFB.

SpaceX would also be required to complete a California Business Plan for the storage of LOX and RP-1 at SLC-4E. A California Business Plan is required to identify hazardous materials stored on the site that exceed 55 gallons for liquids, 500 lbs for solids, or 7.41 yd^3 for compressed gases; or the federal thresholds for extremely hazardous substances. The Business Plan

would be submitted to the Santa Barbara County Fire Department, the local California Unified Program Agency responsible for VAFB.

A Spill Prevention Control and Countermeasures Plan would be required pursuant to federal, state, and local laws and regulations for the ASTs for LOX and RP-1. The ASTs for RP-1 would be registered with the SWRCB pursuant to the state's Aboveground Storage Tank Program for petroleum storage tanks.

In the event of a spill of hazardous materials, the Air Force would provide initial emergency spill response; however, the remainder of emergency/corrective actions would be the responsibility of SpaceX. SpaceX would be responsible for preparing its own Emergency Response Plan for the Falcon 9 and Falcon 9 Heavy launch vehicle programs in accordance with the VAFB Hazardous Materials Emergency Response Plan. This Plan would ensure that adequate and appropriate guidance, policies, and protocols regarding hazardous material incidents and associated emergency response are available to and followed by all installation personnel and commercial entities. In the event of a spill, SpaceX would also be responsible for completing a Community Awareness and Emergency Response reporting form per local Santa Barbara County hazardous material and hazardous waste spill reporting requirements.

3.4.2 Hazardous Waste Management

Management of hazardous waste for the Falcon 9 and Falcon 9 Heavy programs would comply with the RCRA Subtitle C (40 CFR Part 240-299) and with California Hazardous Waste Control Laws as administered by the California EPA, Department of Toxic Substances Control, under Title 22, Division 4.5 of the California Code of Regulations (CCR). These regulations require that hazardous wastes be handled, stored, transported, disposed of, or recycled according to defined procedures. The VAFB *Hazardous Waste Management Plan*, 30 SWP 32-7043A, provides detailed procedures for hazardous waste accumulation and management.

SpaceX would be required to follow all federal, state, and local laws and regulations regulating the generation, storage, transportation, and disposal of hazardous waste. Because the Proposed Action is not a Government action, use of the Air Force Generator Identification Number would not be allowed. SpaceX would need to obtain either a U.S. EPA ID Number or a California ID Number, depending on the amounts and types of waste produced. VAFB employs a "cradle to grave" waste management approach. Generally, hazardous waste follows the 90-day accumulation rules as allowed by regulation, or is stored up to 270 days at authorized satellite accumulation points (SAPs). SAPs are located at the point of generation, and wastes may be stored until 55 gallons of hazardous waste or 1 quart of extremely or acutely hazardous waste is accumulated. When the SAP limit is reached, the waste is transferred in a properly labeled DOT approved container from its point of origin to a Consolidated Collection Accumulation Point (CAP), or to a permitted off-site treatment storage or disposal facility. SpaceX would be responsible for developing its own Hazardous Waste Management Plan for the Falcon 9 and Falcon 9 Heavy programs, in accordance with the VAFB *Hazardous Waste Management Plan*, to document how hazardous wastes would be controlled for the programs. Hazardous waste is removed from VAFB under hazardous waste manifest and shipped off the Base for final disposal.

Hazardous waste management associated with the demolition of existing facilities or structures during the modification of SLC-4E (see Section 2.1.2.1) was previously assessed (VAFB 2005), and is not covered under this EA.

3.4.3 Installation Restoration Program

The Federal Installation Restoration Program (IRP) was implemented at DOD facilities to

identify, characterize, and restore hazardous substance release sites. There are currently 136 IRP sites throughout VAFB grouped into six operable units based on similarity of their characteristics.

IRP sites are remediated through the Federal Facilities Site Remediation Agreement, a working agreement between the USAF, the Central Coast Regional Water Quality Control Board (RWQCB), and the Department of Toxic Substances Control. In addition to IRP sites, there are identified Areas of Concern (AOCs), where potential hazardous material releases are suspected; and Areas of Interest (AOIs), defined as areas with the potential for use and/or presence of a hazardous substance. Various contaminants could be present at these sites including trichloroethylene, polychlorinated biphenyls, volatile organic compounds (VOCs), total petroleum hydrocarbons, asbestos, and other hazardous contaminants.

One IRP site, Site 8, is located within the perimeter fence of SLC-4E. Site 8, is part of the Site 8 Cluster, which also includes Site 9 at SLC-4W and Site 10 at Spring Canyon Pond. These sites are treated as a "site cluster" due to shared geologic, biologic and hydrogeologic settings. IRP Site 8 encompasses the aboveground gantry launch facility. Trichloroethelene, used as a degreaser of missile components, leaked into the underlying vadose zone through cracks and joints in the deluge channel and retention basin concrete lining, eventually reaching groundwater at a depth of 120 ft below ground surface. In addition, a low altitude launch failure in 1986 caused widespread deposition of ammonium perchlorate debris which is believed to have sourced perchlorate in the soil and groundwater. Perchlorate surface soil contamination was determined to be below concentrations at risk to human health (Tetra Tech 2009). The area is populated with multiple wells. Monitoring and injection well locations within the SLC-4E area are illustrated in Figure 3-2.

In September 2006, the Air Force initiated implementation of an *in-situ* bioremediation (ISB) substrate injection pilot test program for treatment of trycholoroethylene and perchlorate impacted groundwater at Site 8/SLC-4E. The ISB treatment system was expanded in February 2008. At the present, groundwater monitoring related to the ISB treatment system and related to the overall groundwater contaminant plume footprint is on-going. Additional ISB substrate injection events at Site 8/SLC-4E cannot be ruled out. Thus, infrastructure modifications and operations at SLC-4E must accommodate IRP groundwater monitoring and remediation activities.

No other IRP, AOC, or AOI sites exist within the SLC-4E fence line.

3.5 Human Health and Safety

The affected environment for Human Health and Safety includes the regulatory environment for health and safety issues established to minimize or eliminate potential risk to the general public and on-Base personnel from the operation of the Falcon 9 and Falcon 9 Heavy programs, as well as to personnel involved in the modifications to SLC-4E under the Proposed Action. The area of potential effects for human health and safety includes those areas on and surrounding VAFB that could be affected by modifications to SLC-4E, and operation of the Falcon 9 and Falcon 9 Heavy programs, including such activities as payload processing and radiating, transport, and launch. All construction activities and program operations are subject to federal, state, and local laws and regulations, and the requirements of the federal OSHA.

The 30 SW/SE office at VAFB reviews, approves, and monitors all pre-launch and launch operations, as well as issues safety holds when necessary, in accordance with AFSPCMAN 91-710, *Range Safety Requirements*. 30 SW/SE ensures that the public, launch area personnel, foreign land masses, and launch area resources are provided with an acceptable level of safety,

Figure 3-2. Monitoring and injections well locations at SLC-4E.

and that all launch operations adhere to public laws.

Industrial hygiene and ground safety during SLC-4E modifications and Falcon 9 and Falcon 9 Heavy program operations would be the responsibility of SpaceX and/or its contractor(s) safety department. Industrial hygiene responsibilities include monitoring and exposure to workplace chemicals, radiation, physical hazards, hearing and respiratory protection, medical monitoring of workers subject to chemical exposures, and oversight of all hazardous or potentially hazardous operations. Ground safety responsibilities include protection from hazardous situations and hazardous materials.

3.5.1 Regional Safety

Emergency Planning

Santa Barbara County has a prepared Hazardous Materials Response Plan in place for countywide disaster response. VAFB plays a role in this regional emergency planning, due to the potential for its operations to affect off-Base areas. Mutual aid agreements between VAFB and various local agencies allow the agencies to support notification and response efforts in case of a VAFB emergency. In the event of a launch mishap that impacts off-Base areas, the VAFB Emergency Operations Center would respond to the accident upon request of the County. Military personnel would assume responsibility for disaster control in the immediate impact area. County agencies would be requested to assist in evacuation and fire control, as needed.

Debris Impact Corridors and Launch Notification

All launch programs at VAFB are required to establish debris impact corridors as a part of their program's safety review, in case of a launch anomaly that requires thrust termination or destructive flight termination. When any launch, including a commercial launch, is scheduled to take place from VAFB, the 30 SW/SEL notifies the 2nd Range Operations Squadron (2 ROPS) of the associated hazard areas. SpaceX has accomplished a debris analysis, as discussed in Section 2.1.1.7, for the Falcon 9 program and would accomplish an analysis for the Falcon 9 Heavy program prior to its first launch. 30 SW/SEL would review and approve these analyses prior to authorizing any launch activities. Impact debris corridors would be established off the Santa Barbara County coast between Point Sal and Point Conception to meet security requirements and reduce hazards to persons and property during launch related activities. Specific debris impact areas would be determined for each launch, based on its specific trajectory.

Once notified of hazard areas by the 30 SW/SEL, the 2 ROPS notifies the FAA so that appropriate airspace restrictions are in place during launches. Offshore maritime zone closures are also put in place, and notification of these areas is broadcast via radio and posted in harbors along the coast, as well as being published in the weekly U.S. Coast Guard Long Beach Broadcast to Mariners.

Offshore oil rigs located west of 120 degrees 15 minutes longitude also have evacuation or shelter-in-place procedures in place for use during launch operations. The 2 ROPS notifies the Minerals Management Service to notify oil rig personnel of launch operations.

Some local beaches, including Ocean Beach and Jalama Beach county parks, also fall within some debris impact corridors necessitating their closures during launch operations. Although the beaches are not directly over flown by the launch vehicles, a launch anomaly could impact them. Therefore, for the safety of park visitors, the County Parks Department and the County Sheriff close the parks upon request from VAFB.

A Union Pacific railroad line runs through VAFB. On south VAFB, the track passes between the Pacific Ocean and the launch facilities, and are over flown during launches. Railroad schedules and close coordination between train engineers and VAFB launch

personnel, ensure that trains are never over flown, to reduce potential risk to people and property. To that end, 30 SW/SEL defines appropriate railroad mile markers to 2 ROPS, who coordinates with the Manager Road Operations (previously referred to as the Trainmaster) to ensure trains are kept clear of the launch area.

Hazardous Materials Transportation Safety

Hazardous materials such as propellants, ordnance, chemicals, and other hazardous material payload components must be transported to VAFB in accordance with DOT regulations for interstate and intrastate shipment of hazardous materials (Title 49 CFR 100-199).

3.5.2 On-Base Safety

Safety processes or procedures, in addition to the mainly regional ones described above, could be relevant to both the general public and personnel on the Base, including construction workers on SLC-4E modifications and personnel involved in the operation of the Falcon 9 and Falcon 9 Heavy programs. Ensuring that safety requirements are met both during modification of SLC-4E and during Falcon 9 and Falcon 9 Heavy programs operations is critical. The following discussion includes requirements that must be met during one or both of these phases.

Toxic Release Contingency Plans and Toxic Hazard Corridors

Toxic hazard assessments would be required for the Falcon 9 and Falcon 9 Heavy programs to determine program-specific toxic material used for launches, payloads, ground support equipment, and at facilities. 30 SW has detailed procedures in place to control use of toxic gases. VAFB maintains 30 SWI 91-106, *Toxic Hazard Assessments*, which defines control measures and procedures for conducting operations involving toxic fuels. Atmospheric and dispersion computer models are run by 30 SW/SE to predict toxic hazard corridors (THCs) for nominal and aborted launches, as well as for spills or releases of toxic materials from storage tanks or that occur during loading or unloading of propellants. 2 ROPS uses THCs to reduce the risk of exposure of launch personnel and the general public from toxic materials, including toxic gases. Dispersion modeling for the Falcon 9 and Falcon 9 Heavy programs would be run for nominal and abort scenarios prior to each launch. If the model predicts THCs over populated areas, the launch would be delayed until meteorological conditions allowed for launch to occur without this risk.

Exposure Criteria

The Air Force Surgeon General (HQ AF/SG) has, through AFMAN 48-155, *Occupational and Environmental Health Exposure Controls,* granted local authority to determine the Occupational and Environmental Exposure Limit (OEEL). The OEEL is defined as, "…the most appropriate limit adopted from established recognized standards including, but not limited to, those in AFIs and AFOSH Standards, the latest edition of the *TLV® Booklet* published annually by the American Conference of Government Industrial Hygienists; 29 CFR 1910.1000 Tables Z-1, Z-2, and Z-3; and 40 CFR 141…" Bioenvironmental Engineering at the 30th Medical Group (30 MDG) will determine the OEEL for chemicals estimated to pose the most significant health concerns to the public and launch facility workers. The exposure criteria are factored into the exposure prediction and risk management models, and the launch commit decisions used by 30 SW/SE at VAFB.

Vehicle Reliability

Standards for vehicle reliability are included in AFPSCMAN 91-710. 30 SW/SE uses data provided from the data requirements in AFSPCMAN 91-710 to determine the overall launch vehicle reliability that is used in the risk assessment models.

Quantity-Distance Criteria

Explosive safety quantity-distance criteria are used to establish safe distances from launch complexes and associated support facilities (in case of launch anomaly) to non-related

facilities and roadways. The criteria are established under DOD and Air Force Explosive Safety Standards (DOD 6055.9 STD and AFMAN 91-201). The criteria utilize the trinitrotoluene (TNT) explosive equivalent of propellant to determine safe distances from space launch operations or processing and holding areas. SLC-4 was originally constructed to meet these criteria under the Titan launch programs.

Management of Hazardous Materials and Waste

During facility modification and construction activities, hazardous materials present on site would mainly be comprised of POLs for operating equipment and vehicles. Hazardous materials would also be used during the operation of the Falcon 9 and Falcon 9 Heavy programs. The potential exists for unexpected releases of these materials, which would generate hazardous waste. Therefore, the potential exists for persons participating in project activities to become exposed to hazardous materials and hazardous waste. See Section 3.4 for further discussion on management of these materials.

Fire Protection

Fire protection, alarm, and fire suppression systems must be provided at all fuel holding areas and support facilities. Flame detectors in the fuel holding areas would activate the area deluge water system and alarms to the 30th Civil Engineer Squadron, Fire Department (30 CES/CEF).

Security and Antiterrorism

Site security requirements, including those for security lighting and intrusion detection, are part of the requirements integral to launch program safety. 30 SWI 31-101, AFI 31-101, and DOD Manual 5220.22-M detail these security requirements.

Unified Facilities Criteria (UFC) 4-010-01 was issued in January 2007 under the authority of DOD Instruction 2000.16, *Antiterrorism Standards*. This guidance requires DOD components to adopt and adhere to common definitions, criteria, and minimum construction standards for building to mitigate vulnerabilities and terrorist threats. Modifications to SLC-4E made by SpaceX would be required to meet these construction standards.

Physical Safety

Physical features present in the vicinity of proposed project area, have the potential to adversely impact the health and safety of workers on site. Physical hazards including traffic on the roads, holes and ditches, uneven terrain, sharp or protruding objects, slippery soils or mud, and unstable ground could be present. Additionally, biological hazards such as animals (insects, spiders, and snakes), and disease vectors (ticks and rodents) could be present on site.

Unexploded Ordnance

Several areas on VAFB were used as ordnance training ranges and have the potential to contain unexploded ordnance (UXO). Since ordnance can be found in several areas on Base, the Explosive Ordnance Disposal (EOD) Flight must coordinate on all ground disturbing projects. According to EOD guidance, if ordnance is found on the site, it should not be disturbed. Workers in the vicinity must be alerted to the danger and directed away from it, and the EOD Flight must be contacted.

Noise

The Noise Control Act (NCA; 42 U.S.C. 4901 et seq.) sought to limit the exposure and disturbance that individuals and communities experience from noise. It focuses on surface transportation and construction sources, particularly near airport environments. The NCA also specifies that performance standards for transportation equipment be established with the assistance of the DOT. Section 7 of the NCA regulates sonic booms and gave the FAA regulatory authority after consultation with the U.S. EPA. In 1987, the Quiet Community amendment gave state and local authorities greater involvement in controlling noise.

Noise is often defined as unwanted sound that can interfere with normal activities or otherwise diminish the quality of the environment. Depending on the noise level, it has the potential to disrupt sleep, interfere with speech communication, or cause temporary or permanent changes in hearing sensitivity in humans and wildlife. Noise sources can be continuous (e.g., constant noise from traffic or air conditioning units) or transient in nature (e.g., a rocket launch, sonic boom, jet overflight, or an explosion). Noise sources also have a broad range of frequency content (pitch) and can be nondescript, such as noise from traffic, or be specific and readily definable, such as a whistle or a horn. The way the acoustic environment is perceived by a receptor (animal or person) is dependent on the hearing capabilities of the receptor at the frequency of the noise, and their perception of the noise (URS Corporation 1986).

The amplitude of sound is described in a unit called the decibel (dB). A-weighting is a standard filter used in acoustics that approximates human hearing and is in some cases the most appropriate weighting filter when investigating the impacts of noise on wildlife as well as humans. Examples of A-weighted noise levels for various common noise sources are shown in Table 3-6.

Existing noise levels on VAFB are generally quite low due to the large areas of undeveloped landscape and relatively sparse noise sources. Background noise levels are primarily driven by wind noise; however, louder noise levels can be found near industrial facilities and transportation routes. On VAFB, general ambient one-hour average sound level (L_{eq1H}) measurements have been found to range from around 35 to 60 dB (Thorson et al. 2001). Rocket launches and aircraft overflights create louder intermittent noise levels.

Launch noise is intermittent. Four types of noise generally occur during a launch: 1) combustion noise from the launch vehicle chambers, 2) jet noise generated by the interaction of the exhaust jet and the atmosphere, 3) combustion noise from post-burning of combustion products, and 4) sonic booms (SpaceX 2003). The first three of these types of noise are often collectively referred to as “launch noise” and occur in the vicinity of the launch pad. Sonic boom noise impacts typically occur downrange from the rocket launch pad and are orientated along the path of the vehicle’s trajectory, which for launches from VAFB are directed over the Pacific Ocean.

Table 3-6. Comparative A-weighted sound levels.

Noise Level (dBA)	Common Noise Levels	
	Indoor	Outdoor
100 – 110	Rock band inside New York subway	Jet flyover at 997 ft
90 – 100	Food blender at 3.28 ft	Gas lawnmower at 3.28 ft
80 – 90	Garbage disposal at 3.28 ft	Diesel truck at 49.21 ft; noisy urban daytime
70 – 80	Shouting at 3.28 ft; vacuum cleaner at 3 m	Gas lawnmower at 98 ft
60 – 70	Normal speech at 3.28 ft	Commercial area heavy traffic at 328 ft
50 – 60	Large business office; dishwasher next room	
40 – 50	Small theater or large conference room (background)	Quiet urban nighttime
30 - 40	Library (background)	Quiet suburban nighttime
20 - 30	Bedroom at night	Quiet rural nighttime
10 - 20	Broadcast and recording studio (background)	
0 – 10	Threshold of hearing	

A sonic boom is the shock wave resulting from the displacement of air in supersonic flight, such as that which occurs during space launch vehicle flight. Sonic booms differ from other sounds in that they are impulsive and the boom event at each position is very brief (less than a second). Sonic booms are generally described by their peak overpressure in pounds per square foot (psf; SpaceX 2003). Sonic booms produced by launches from VAFB would impact the ocean and have the potential to impact the main NCI, located approximately 40 to 75 miles southeast of SLC-4E. The three main islands comprising the NCI include SMI, Santa Rosa Island (SRI), and Santa Cruz Island (SCI).

Noise produced during construction is relatively continuous. Noise levels typical of heavy construction equipment, as would be used under the Proposed Action, are presented in Table 3-7.

3.6 Orbital Debris

Orbital debris is any manmade object in orbit about the Earth which no longer serves a useful purpose. Examples of orbital debris include derelict spacecraft and upper stages of launch vehicles, debris intentionally released during spacecraft separation from its launch vehicle or during mission operations, debris created as a result of spacecraft or upper stage explosions or collisions, solid rocket motor effluents, and tiny flecks of paint released by thermal stress or small particles (NASA 2009).

Approximately 19,000 objects larger than approximately 4 inches are known to exist and are tracked routinely by the U.S. Space Surveillance Network. Approximately 500,000 particles between 0.4 and 3.9 inches are estimated to exist, while it is likely that the number of particles smaller than 0.4 inch exceeds tens of millions (NASA 2009). Most

Table 3-7. Noise levels of heavy construction equipment.

Equipment Item	Maximum Noise Level (dBA) at 50 ft	Equipment Item	Maximum Noise Level (dBA) at 50 ft
All other equipment > 5 Horsepower	85	Gradall	85
Auger Drill Rig	85	Grader	85
Backhoe	80	Horizontal Boring Hydraulic Jack	80
Bar Bender	80	In-situ Soil Sampling Rig	84
Boring Jack Power Unit	80	Jackhammer	85
Chain Saw	85	Paver	85
Compactor (ground)	80	Pickup Truck	55
Compressor (air)	80	Pneumatic Tools	85
Concrete Batch Plant	83	Pumps	77
Concrete Mixer Truck	85	Rock Drill	85
Concrete Pump	82	Scraper	85
Crane (mobile or stationary)	85	Slurry Plant	78
Dozer	85	Slurry Trenching Machine	82
Dump Truck	84	Soil Mix Drill Rig	80
Excavator	85	Tractor	84
Flat Bed Truck	84	Vacuum Excavator (vac-truck)	85
Front End Loader	80	Vacuum Street Sweeper	80
Generator (25 KVA or less)	70	Vibratory Concrete Mixer	80
Generator (more than 25 KVA)	82	Welder	73

SOURCE: Commonwealth of Massachusetts, Section 721.560 Construction Noise Control - http://www.nonoise.org/resource/construc/bigdig.htm

orbital debris reside within 1,242 miles of the Earth's surface, while the volume present varies significantly with altitude. The greatest concentrations of debris are found near 497 to 528 miles of the surface.

Satellite explosions and collisions are the principal source of "large" orbital debris (i.e. greater than 4 inches). Prior to 2007, old upper launch vehicle stages left in orbit with stored energy sources, e.g. residual propellants and high pressure fluids, were the principal sources. In 2007, China intentionally destroyed a weather satellite, and in 2009 there was an accidental collision between American and Russian communication satellites, which greatly increased the number of large debris in orbit (NASA 2009). These two breakups created about 5,000 objects larger than 3.9 inches and increased the cataloged populations by approximately 50 percent (Liou 2010).

The length of time the debris remains in orbit is dependent on its altitude. The higher the altitude, the longer the debris will typically remain in Earth orbit. Debris in orbit below 373 miles normally fall back to Earth within several years, while the orbital decay for debris at altitudes of over 497 miles can be measured in decades. Debris present above 621 miles will normally continue orbiting for a century or more (NASA 2009).

Orbital debris is a concern to spacecraft, including the Dragon capsule, due to potential of collision hazards. However, operational spacecraft are struck by very small debris and micrometeroids routinely with little or no effect. Debris shields can also be employed to protect spacecraft components from particles as large as 0.4 inch in diameter. And the probability of two large objects accidentally colliding is very low (NASA 2009).

Large pieces of debris are also of concern with respect to their re-entry and potential to impact the Earth. However, a significant amount of debris does not survive the severe heating which occurs during the re-entry process. Components that do survive are most likely to fall into oceans or other bodies of water or sparsely populated regions like the Canadian Tundra, Australian Outback, etc. (NASA 2009).

Since 1988, it has been the official U.S. policy to minimize the creation of new orbital debris. The most recent National Space Policy (28 June 2010) states that the United States shall "lead the continued development and adoptions of international and industry standards and policies to minimize debris…" This will be done "For the purpose of minimizing debris and preserving the space environment for the responsible, peaceful, and safe use of all users..."

In 1995, NASA was the first space agency in the world to issue a comprehensive set of orbital debris mitigation guidelines. Based on the NASA guidelines, a set of U.S. Government Orbital Debris Mitigation Standard Practices was developed in 1997 and approved in 2001.

3.7 Socioeconomics

The influence of VAFB on population and employment within Santa Barbara County varies widely. VAFB directly contributes more than $500 million each year to the economies of Santa Barbara County and California through its hiring and purchasing. The Base is the second largest employer in Santa Barbara County with an employment level of 7,400 people as of 2007. This includes 3,474 military personnel, 849 civil servants, and 3,149 non-appropriated fund, contractor, and private business personnel (VAFB 2007a).

VAFB generally influences northern Santa Barbara County, which encompasses the city of Lompoc, the unincorporated area north of Lompoc, and the Santa Maria Valley. Although VAFB draws commuters from southern San Luis Obispo County, commuters from this region comprise fewer than 5 percent of the total San Luis Obispo County work force (SpaceX 2003).

As of July 2006, the Santa Barbara County population was estimated at 421,656 people.

Santa Maria and Lompoc, with 90,204 and 41,915 residents respectively, are the principal communities within the northern portion of the county. They are the first and third largest cities respectively, in the county (California Department of Finance, Economic Research 2007).

In 2006, Santa Barbara County had 172,890 non-agricultural wage and salary employments. Of these, construction-related industry accounted for 10,480 jobs or 6.1 percent of the 2006 total (California Department of Finance, Economic Research 2007).

3.8 Solid Waste Management

In 1989, the California Integrated Waste Management Act (Assembly Bill 939) established a 50 percent diversion goal in the quantity of solid waste disposed of in California landfills. The 50 percent diversion was to be accomplished by January 1, 2000, and was measured against a 1990 baseline. Solid waste diversion requirements applicable to this EA were enacted through California Senate Bill 1374, *Solid Waste: Construction and Demolition Waste Materials: Diversion Requirements Model Ordinance.* On March 1, 2004, the California Integrated Waste Management Board (CIWMB) promulgated a model ordinance for local agencies to follow for implementing a 50 to 75 percent diversion of construction and demolition (C&D) debris waste materials from landfills. Currently, the local enforcement agency (LEA), the Santa Barbara County Environmental Health Services Division, has not promulgated its final model ordinance. A locally adopted diversion ordinance would affect requirements and operations at area landfills, as they would be within the Santa Barbara County wasteshed.

Commercial operations with leased facilities on VAFB do not have access to the Base Landfill, and make their own arrangements for solid waste management. SpaceX anticipates using an approved facility, such as the City of Santa Maria Landfill (CSML) or the Lompoc Sanitary Landfill. The CSML is approximately 290 acres, including 265 acres designated for use as landfill. It includes inactive, active, and borrow areas. Approximately 186 of the 265 available acres are used for refuse disposal. Approximately 118 acres are currently used for landfill. It is estimated to have approximately 1.8 million tons of waste in place, with an estimated waste acceptance design capacity of 12,814,815 yd^3.

CSML, which has been in operation since 1955, is a non-hazardous solid waste disposal site with an active landfill gas collection and control system. In general the landfill has been developed from the northwest to the southeast, and the northwest portion of the landfill is active and includes an intermediate cover soil borrow area covering about 79 acres. Landfill operations consist of a fill-and-cover method, using onsite soils to provide daily cover. Based on the current waste acceptance rate, the landfill has sufficient capacity to operate until 2018. CSML receives an annual average of about 300 metric tons of municipal solid waste per day (based on past 3 years' data). It operates under Solid Waste Facility Permit (SWFP) #42-AA-0016, which allows the facility to handle up to 858 tons per day of waste. The facility includes a recycling program.

The Lompoc Sanitary Landfill, which has been in operation since 1961, is permitted to accept 400 tons/day of construction/ demolition and mixed municipal waste (CalRecycle 2010). As of 2000, its total estimated permitted capacity is 4,560,000 cubic yards, with approximately 52.9 percent used, and a remaining 47.1 percent available (2,146,779 yd^3). Based on capacity information from 2000, its estimated closure date would occur in 2047 (CalRecycle 2010). The Lompoc Sanitary Landfill operates under SWFP #42-AA-0017.

VAFB currently requires an 85 percent diversion rate by weight for C&D materials. Inert materials are highly recyclable with proper pre-planning for segregation and

onsite management. Steel, non-chemically treated wood, concrete, waste soil, and asphalt generated as a result of demolition actions would be expected to have a diversion rate higher than 85 percent. Typically, such materials are 100 percent divertible with proper planning and practices.

Construction and Demolition Debris

There are different processes established for handling and disposing of C&D debris. Debris from new construction is typically uncontaminated and is reused or recycled whenever feasible. Material segregation and storage are also less of a problem with new construction than with demolition. Debris from demolition projects is sometimes less amenable to reuse or recycle because, based on facility age, the structure may be painted with lead-based paint, contain asbestos-containing materials, and have treated woods in structural and finishing materials. This debris may have to be managed as hazardous waste. Demolition projects must often overcome cost differentials wherein it may be less expensive to demolish a structure than to deconstruct or dismantle it. Cost differentials between tipping fees and costs associated with reuse or recycling also influence disposal decisions.

Pollution Prevention

The State of California has mandated a reduction in the quantity of solid waste disposed of in landfills. The Pollution Prevention Act (PPA) of 1990 refocused the national approach to environmental protection toward pollution prevention (P2). The P2 program elements are implemented by following the P2 hierarchy:

- Reduce (source reduction to prevent the creation of wastes)
- Reuse (keep item or material for its intended purpose)
- Recycle (use item or material for some other beneficial purpose)
- Disposal (in an environmentally compliant manner, only as a last resort)

3.9 Transportation

Existing roadway conditions are evaluated based on roadway capacity and traffic volume. The capacity, which reflects the ability of the network to serve the traffic demand of a roadway, depends on the roadway width, number of lanes, intersection control, and other physical factors. Traffic volumes can be reported as the number of vehicles averaged over a daily period (average daily traffic or ADT).

A road's ability to accommodate different volumes of traffic is generally expressed in terms of Level of Service (LOS). The Institute of Transportation Engineers (ITE; ITE 1982) defines LOS as "a qualitative measure that incorporates the collective factors of speed, travel time, traffic interruptions, freedom to maneuver, safety, driving comfort, and convenience, and operating costs provided by a highway facility under a particular condition." The LOS scale ranges from A to F, with each level defined by a range of traffic volume to roadway capacity (V/C). LOS A represents the best operating conditions, while an LOS F represents the worst (Table 3-8).

Table 3-8. Conditions for LOS.

LOS Level	Condition
A	Traffic flows at or above the posted speed limit and all motorists have complete mobility between lanes.
B	Traffic slightly more congested than LOS A, but speed remains the same. Some restrictions to maneuverability; motorists may drive side by side limiting lane changes.
C	More congestion than LOS B. Ability to pass or change lanes not always assured. Target for most urban highways and most rural highways. Roads are efficiently close to capacity, and posted speed is maintained.
D	Speeds are somewhat reduced, motorists are restricted by other cars and trucks. Equivalent to a functional urban highway during commuting hours. Common goal for urban streets during peak hours.
E	Flow becomes irregular and speed varies rapidly without reaching posted limits. Consistent with a road at or approaching its designated capacity.
F	Lowest measure of efficiency. Flow is forced, with all vehicles restricted by those in front; frequent slowing required. This is a road in a constant traffic jam.

3.9.1 Regional Access

VAFB is located approximately 5 miles west of the City of Lompoc. As shown in Figure 1-1 (Chapter 1), the main access route to VAFB is Highway (Hwy) 101. Hwy 101 is a coastal four-lane divided freeway connecting northern California to southern California. The VAFB connections to Hwy 101 are Hwy 1, State Route (SR) 135, and SR 246. Hwy 1, a north-south highway, traverses VAFB and provides access to Santa Maria to the northeast, and Santa Barbara to the southeast. When used in conjunction with Hwy 101, SR 246, an east-west highway, provides access to Lompoc to the east, and Santa Barbara to the southeast. SR 135 and SR 246 are mostly two-lane undivided highways with four-lane rural expressway portions.

Space vehicle parts, hazardous materials, hypergolic fuels, and other materials necessary for Falcon 9 and Falcon 9 Heavy program operations could originate from within or outside of California. Once in the vicinity of VAFB, construction workers, oversized trucks bringing space launch vehicle parts and other materials, as well as operational personnel, would likely use SR 246 to reach VAFB before proceeding to SLC-4E.

SR 246 is accessible from the south through Hwy 1 and Hwy 101. It is likely that any construction or oversize trucks would access SR 246 from Hwy 101. From the north, SR 246 would be accessed through the city of Lompoc, at Hwy 1 (H Street) and Ocean Avenue. This route is not likely to be used as it entails traversing the entire length of Lompoc. It is more likely that any large construction trucks or oversize trucks would travel south on Hwy 101 to SR 246 in Buellton, CA and take it west to either the South Gate or the Coast Gate (depending on their size).

SR 246 services the South Base Gate, the primary access for south VAFB. Further west, at the terminus of SR 246, is the Coast Gate, which is normally closed, but is occasionally opened for oversized shipments to south VAFB. SLC-4E lies within the entry-controlled area of south VAFB. Only authorized military personnel and their families, civilian employees of Base with approved identification, and visitors with pre-approved authorization, can enter the entry-controlled area.

3.9.2 Access to Project Site

Workers and construction equipment for this project would likely access the Base through the South VAFB Gate, and proceed south on Arguello Road, then west on Bear Creek Road to access Coast Road (Figure 1-2, Chapter 1). They would proceed south on Coast Road until reaching Kelp Road, and then proceed east on Kelp Road to SLC-4E.

Oversized trucks bringing space launch vehicle parts or construction materials would likely take SR 246 to its terminus, and enter VAFB through the Coast Gate. They would then proceed south on Coast Road until reaching Kelp Road, and then proceed east to SLC-4E. Demolition materials that could not be reused on site would be loaded onto trucks and hauled to the CSML, or another approved facility in accordance with approved traffic control and haul route plans.

On VAFB, roads are categorized as highways, primary, local (secondary roads), and patrol (VAFB 2007a). Primary roads serve large volumes of traffic, are divided, and provide limited access to adjacent land uses. They act as the main circulation routes into and through the cantonment areas and connect to local streets (VAFB 2004). Local streets provide for traffic movement between primary roads and access roads and provide access to community facilities, parking lots, and housing and service areas. They make up the majority of the road network in the cantonment area and have frequent traffic stops and low speeds. (VAFB 2004) Patrol roads are remote roads that are paved or unpaved and are used for security patrol and monitoring of infrastructure (VAFB 2004).

On South Base the primary roads include Arguello Road, Bear Creek Road and Coast Road (VAFB 1994a), all of which could be

used to access SLC-4E. All primary roads on VAFB operate at a LOS between A and C (VAFB 1994b). Local (secondary) roads operate at a LOS between A and B (VAFB 1994b). Informal traffic studies indicate gates operate at LOS A to C range (VAFB 2005).

3.10 Water Resources

Water resources include surface water and groundwater and their physical, chemical, and biological characteristics. Surface water includes lakes, rivers, streams, and wetlands, while groundwater refers to water below the surface. Industrial or hazardous waste management, as it applies to water resources, is also discussed in this section.

The Clean Water Act (CWA) establishes the structure for regulating discharges of pollutants in Waters of the U.S. The CWA mandates the National Pollutant Discharge Elimination System (NPDES) program, which requires a permit for the discharge of any pollutant to Waters of the U.S. from point and non-point sources. Point sources include wastewater from any discernible confined and discrete conveyances from which pollutants are or may be discharged. Non-point sources include stormwater runoff from industrial, municipal, and construction sites. The CWA and implementing U.S. EPA regulations provide the authority and framework for state regulations. In California, the SWRCB administers the NPDES program through the Porter Cologne Water Quality Act/California Water Code. The SWRCB and the RWQCBs administer the NPDES Program for industrial activities, municipalities and construction activities through General Permits, although certain discharges are authorized and certain discharges require individual permits. VAFB is in the jurisdiction of the Region 3, Central Coast RWQCB.

3.10.1 Surface Water

The California Porter-Cologne Water Quality Act provides a framework for establishing beneficial uses of water resources and the development of local water quality objectives to protect these beneficial uses. The Central Coast Water Quality Control Plan (Basin Plan) assigns beneficial uses to water bodies and provides local water quality objectives to protect these beneficial uses. The California Ocean Plan provides water quality objectives to protect ocean water quality.

The Santa Ynez River is considered the dividing line between North and South VAFB. Three major drainages occur on south VAFB: Bear Creek, Cañada Honda Creek, and Jalama Creek. There are also numerous unnamed minor drainage basins containing seasonal and ephemeral streams. Drainage from these basins is predominantly to the west, toward the Pacific Ocean. Surface water resources in the vicinity of SLC-4E include Spring Canyon Creek and the Pacific Ocean.

Spring Canyon Creek, approximately 0.1 mile south of SLC-4E, originates approximately 1.4 miles inland and flows toward the ocean. Lower Spring Canyon is an ephemeral creek that often has standing water upstream of Surf Road. Surface flow percolates into the groundwater to pass beneath road embankments and eventually enters the Pacific Ocean (USAF 1987). Lower Spring Canyon was sampled during the VAFB Ambient Monitoring Program from December 2005 to December 2006. Low flow and highly saturated soil conditions were causing anaerobic decomposition, suppressing the dissolved oxygen and pH levels, increasing metals concentration. The results for metals exceeded the criteria in 13 of 20 metals analyzed (VAFB 2006). There was also a large amount of leaf litter that appeared to be decomposing into a thick, orange substance. Spring Canyon has no designated beneficial uses identified in the Basin Plan (SWRCB 2008). However, the Basin Plan also provides the following designations for surface water bodies that do not have beneficial uses designated:

- Municipal and domestic water supply; and
- Protection of both recreation and aquatic life.

These designations would apply to Spring Canyon Creek. Construction and operational activities at SLC-4E in support of the Falcon 9 and Falcon 9 Heavy programs must protect the water quality objectives associated with these beneficial uses.

3.10.2 Groundwater

VAFB includes parts of two major groundwater basins, and at least two sub-basins. Most of the northern third of the Base is within the San Antonio Creek Basin, while most of the southern two-thirds of the Base are within the Santa Ynez River Basin and associated Lompoc Terrace and Cañada Honda sub-basins.

SLC-4E is located on the southern margin of the Santa Ynez River groundwater basin/Lompoc Terrace sub-basin. Groundwater at the site is unconfined and restricted to the unconsolidated material immediately above Sisquoc Formation bedrock. An erosional paleomarine terrace of Sisquoc shale bedrock has been noted within Spring Canyon and the launch pad area. The bedrock surface has been affected by interaction with groundwater resulting in a physical and chemical change from shale to clay. The weathered clay bedrock effectively forms an aquitard, thereby limiting the infiltration of groundwater into the underlying Sisquoc Formation. Groundwater is typically found approximately 50 to 140 ft below ground surface. Predominant groundwater flow is toward the Pacific Ocean (USAF 1988).

3.10.3 Stormwater

The California NPDES Construction General Permit regulates the discharge of pollutants in stormwater to Waters of the U.S. (and to drainage basins that are hydrologically connected to Waters of the U.S.) from construction sites that disturb 1 or more acres of soil. The general storm water rainy season at VAFB is from 1 October to 15 April. This timeframe has the greatest potential for site pollutant runoff. The average annual rainfall is approximately 14.8 inches (unpublished data, 30 SW).

VAFB was enrolled in the California Municipal General Permit (Order No. 2003-0005-DWQ) on 27 April 2010. This permit requires VAFB to implement the Storm Water Management Plan to reduce the discharge of pollutants in stormwater discharges and non-stormwater discharges to the maximum extent practicable to protect water quality.

In addition, an Industrial Storm Water General Permit Order 97-03 DWQ (General Industrial Permit) would be required for the Proposed Action. This permit is an NPDES permit that regulates discharges associated with 10 broad categories of industrial activities. The General Industrial Permit requires the implementation of management measures that will achieve the performance standard of best available technology economically achievable and best conventional pollutant control technology. The General Industrial Permit also requires the development of a Storm Water Pollution Prevention Plan (SWPPP) and a monitoring plan. Through the SWPPP, sources of pollutants are to be identified and the means to manage the sources to reduce storm water pollution are described.

The Energy Independence and Security Act of 2007, Section 438, requires any development or redevelopment project involving a Federal facility with a footprint that exceeds 5,000 square feet shall use site planning, design, construction, and maintenance strategies for the property to maintain or restore, to the maximum extent technically feasible, the predevelopment hydrology of the property with regard to the temperature, rate, volume, and duration of flow. DOD policy offers guidance on implementation of the EPA Technical Guidance.

3.10.4 Wastewater Management

On VAFB, the 30th Civil Engineer Squadron, Asset Management Flight, Environmental Quality (30 CES/CEANQ) Water Resources section reviews all requests for wastewater

discharge, including discharges of wastewater to grade, to the sanitary sewer system, and to industrial wastewater treatment facilities, to protect groundwater quality and comply with state water quality regulations. Depending on the contaminant types and levels, wastewater that is not clean enough to go to grade must be disposed of as industrial wastewater or hazardous wastewater. The Wastewater Management Plan provides guidance for discharges of wastewater on VAFB.

3.10.5 Domestic Wastewater Management

Domestic wastewater generated at SLC-4E would be managed via the existing septic sewer system during refurbishments and operation of the Falcon 9 and Falcon 9 Heavy programs. The existing septic system would be evaluated to determine if the system has sufficient capacity to support the number of personnel anticipated to be present during construction and operational activities. If it is determined to not have sufficient capacity, SpaceX would re-evaluate the management of domestic wastewater.

3.10.6 Water Supply

VAFB purchases water from the California Department of Water Resources State Water Project. In addition, four groundwater production wells located in the San Antonio Creek-Barka Slough area are used to supplement the VAFB state water. The San Antonio Water Basin has inputs of 15,000 acre-ft/year (Santa Barbara County Public Works Department 2010). Groundwater is treated prior to its usage as potable water. In 2009, VAFB pumped approximately 1,424 acre-ft (equivalent to 158 acre-ft/month) from the San Antonio Creek groundwater production wells over a 9-month, non-consecutive period.

Approximately 550,000 gallons (1.69 acre-ft) per year of potable water would be required for the launch deluge water system. In addition, a maximum of 120,000 gallons (0.37 acre-ft) per year would be required to support the personnel and facilities during refurbishment and operational activities at SLC-4E.

Chapter 4. Environmental Consequences

This chapter presents the results of the analysis of potential environmental effects of implementing the Proposed Action and No-Action Alternative as described in Chapter 2. For each environmental resource, anticipated impacts are assessed considering short- and long-term effects.

4.1 Air Quality

Potential impacts to air quality from the Proposed Action could result from both construction emissions associated with the modifications to SLC-4E and from the Falcon 9 and Falcon 9 Heavy launch vehicle program operations, including launch activities. Determining potential impacts involves estimating emissions generated from the proposed activities and assessing their impacts on air quality. Potential impacts were evaluated based on calculated direct and indirect emissions associated with implementation of the Proposed Action and the No-Action Alternative. Significant air quality impacts would occur if implementation of any of the alternatives would directly or indirectly:

- Expose people to localized (as opposed to regional) air pollutant concentrations that violate state or federal ambient air quality standards;
- Cause a net increase in pollutant or pollutant precursor emissions that exceeds relevant emission significance thresholds (such as the numerical values of major source thresholds for non-attainment pollutants); or
- Conflict with adopted air quality management plan policies or programs; or
- Exceed caps (limits) as imposed by federal and California GHG regulations. Note these regulations are in draft stage, but would likely be in place during project execution.

Criteria to determine the significance of air quality impacts are based on federal, state, and local air pollution standards and regulations. Under SBCAPCD Rule 202 D 16, if the combined emissions from all construction equipment used to construct a stationary source, which requires an Authority to Construct, have the potential to exceed 25 tons of any pollutant except CO in a 12-month period, the owner of the stationary source shall provide offsets under the provisions of Rule 804 and shall demonstrate that no ambient air quality standard would be violated. Standard dust control measures must be implemented for any discretionary project involving earth-moving activities. Some projects have the potential for construction-related dust to cause a nuisance. Since Santa Barbara County violates the state standard for PM_{10}, dust mitigation measures are required for all discretionary construction activities regardless of the significance of the fugitive dust impacts based on the policies in the 1979 Air Quality Attainment Plan. Furthermore, construction activities must comply with the requirements of SBCAPCD Rule 345, Control of Fugitive Dust from Construction and Demolition Activities. Under Rule 345, construction, demolition, and/or earthmoving activities are prohibited from causing discharge of visible dust outside the property line; and must utilize standard best management practices (BMPs) to minimize dust from truck hauling, track-out/carry-out from active construction sites, and demolition activities.

To determine the significance of operational impacts, the federal major source thresholds for criteria pollutants of 100 tons per year, which is the major source threshold under 40 CFR 70 (Federal Operating Permit Program), were used for all pollutants. For

purposes of this air quality analysis, project emissions within the VAFB region would be potentially significant if they exceed these thresholds. This is a conservative approach, as the analysis compares emissions from both project related stationary and mobile sources to these thresholds.

If emissions exceed a significance threshold described above, further analysis of the emissions and their consequences would be performed to assess whether there was likelihood of a significant impact to air quality. The nature and extent of such analysis would depend on the specific circumstances. The analysis could range from simply a more detailed and precise examination of the likely emitting activities and equipment, to air dispersion modeling analyses. If the Proposed Action emissions were determined to increase ambient pollutant levels from below to above a national or state ambient air quality standard, these emissions would be significant.

4.1.1 Proposed Action

The Proposed Action consists of the modifications to SLC-4E, as well as the operation of the Falcon 9 and Falcon 9 Heavy launch vehicle programs, as described in Chapter 2. Potential impacts to air resources from these phases are described independently below, and are followed by an analysis of potential impacts from GHG, which includes both phases. Demolition of existing facilities at SLC-4E was previously assessed (VAFB 2005) and is not covered under this EA.

The Falcon 9 and Falcon 9 Heavy launch vehicles would use LOX and RP-1 as fuels. During the fuel loading activities any emissions of LOX would be negligible and would not have a negative air quality impact. Emissions of RP-1 during fueling would be avoided through the use of zero-leak quick-disconnect fittings. In addition, SpaceX would have at least one permitted scrubber available to support fueling or offloading operations when needed.

SBCAPCD Rule 202, Exemptions to Rule 201, sets forth the source categories for which an Authority to Construct or Permit to Operate shall not be required. Rule 202(V)(10) specifically exempts closed loop transfer of rocket propellant from a tanker truck, cylindrical tank, or drum, to a satellite, satellite placement system, nutation control system, apogee kick motor, or any other non-booster segment of a space launch vehicle, provided there is no venting of vapors to the atmosphere during the propellant transfer.

SpaceX anticipates using standard solvents such as IPA, and acetone. Additionally, abrasive blasting is possible (although large quantities are not anticipated) for periodic maintenance (every 2 to 3 years) of launch stand structures. The use of paint, although not quantifiable at this time, would be in accordance with California law. The use of any of these materials would comply with SBCAPCD Rules 201, 321, 322, 330, and 337, as described in Section 3.1.4 of this EA.

4.1.1.1 Modification of SLC-4E

Activities included under the modification of SLC-4E would include the following:

- Modification of existing structures at SLC-4E, including administrative building improvements, propellant tank installation, reinstallation (or re-initiation) of utilities, resurfacing of the launch water deluge drainage and retention basin, and resurfacing of the entrance road.

- New construction, including a new Integration and Processing Hangar to be constructed within the current perimeter of the complex. This facility would require approximately 30,000 ft^2 of space (250 by 120 by 75 ft high) plus up to approximately 50 by 150 ft of paved area for vehicle maneuvering, and a 20 ft wide access road to the side of the Hangar. For purpose of estimating emissions associated with fine site grading, it was assumed that 2 acres of grading would be required.

- Installation of two 200 KVa diesel generators, used in addition to the VAFB

power supply, for emergency back-up purposes during launch operations. Each generator is anticipated to operate for a maximum of 336 hours per year, which would include back-up operations and any necessary maintenance activities.

Modifications to SLC-4E, including the construction of the Hangar, would be anticipated to last approximately 24 months, once initial demolition of the existing mobile service tower is completed. Up to 100 local and 100 transient workers, for a total of 200 workers, would be anticipated at SLC-4E during refurbishment and construction efforts.

Air quality impacts from proposed construction activities would occur from: (1) combustion emissions due to the use of fossil fuel-powered equipment, and (2) fugitive dust emissions (PM_{10} and $PM_{2.5}$) during earth-moving activities and materials handling. Equipment anticipated to be used for the modifications is included in Chapter 2, Table 2-2.

Specific construction requirements are not accurately known at this time given that the project is in the design stage; however, they have been estimated for the purpose of this analysis. To ensure that the project would not exceed construction emission standards estimated below, records of construction equipment and truck trips would be maintained by the construction contractor to accurately account for emissions that occur during project implementation. If required, the records and associated emission calculations would be provided for reporting purposes to the SBCAPCD.

Factors needed to derive construction source emission rates were obtained from *Compilation of Air Pollution Emission Factors, AP-42, Volume I* (U.S. EPA 2002), the South Coast Air Quality Management District's (SCAQMD) California Environmental Quality Act Air Quality Handbook (SCAQMD 1999), the CARB's OFFROAD emission factors from the OFFROAD2007 Model (CARB 2007a), and the EMFAC2007 (CARB 2007b) model.

In addition to construction emissions from onsite equipment use and fugitive dust, emissions from construction workers commuting to and from the construction sites, and emissions associated with trucks hauling material from the construction sites to various disposal sites were calculated using emission factors from the CARB's EMFAC2007. A complete description of the construction assumptions, equipment required for construction, estimates of workforce requirements, and haul truck travel are provided in Appendix A, along with the emission calculations for construction activities. Construction emissions are summarized in Table 4-1. As shown, construction emissions would not exceed the significance thresholds for any criteria pollutant. Thus, construction during the Proposed Action would result in less than significant impacts to air quality.

Table 4-1. Proposed Action construction emissions (tons/year).

	CO	VOCs	NO_x	SO_x	PM_{10}	$PM_{2.5}$
SLC-4E Modifications						
Heavy Construction Equipment	0.41	0.23	1.28	0.00	0.06	0.05
Construction Delivery Trucks	0.46	0.09	1.59	0.00	0.06	0.06
Construction Worker Travel	13.99	0.79	1.47	0.01	0.08	0.08
Asphalt Off-gassing (Paved Area)	-	0.0006	-	-	-	-
Architectural Coatings Emissions	-	0.14	-	-	-	-
Fugitive Dust	-	-	-	-	0.02	0.004
Total	***14.86***	***1.25***	***4.34***	***0.01***	***0.22***	***0.19***
Construction Significance Threshold	25	25	25	25	25	25
Exceeds Threshold?	No	No	No	No	No	No

4.1.1.2 Falcon 9 and Falcon 9 Heavy Operations

This analysis follows the methodology that was used in the analysis conducted for the SpaceX Falcon 1 and 9 Launch Program at Cape Canaveral Air Force Station (CCAFS; SpaceX 2007), and the analysis conducted for the Falcon 9 launch vehicle at the Wallops Flight Facility Launch Range (URS Group Inc. 2009). The CCAFS analysis compared the Falcon launch vehicles to previously analyzed vehicles and spacecraft as part of NASA's Routine Payload Final EA (NASA 2002). Because the vehicles and spacecraft analyzed in the NASA EA are the same for CCAFS and VAFB, the calculations of emissions would be the same.

In the CCAFS analysis, all candidate launch vehicles considered for launch of routine payload spacecraft were determined to have no substantial impact on air quality. While the calculations of emissions for VAFB would be the same as for CCAFS and the Wallops Flight Facility, the regulatory environment is different at each of these locations; thus the analysis of potential environmental effects would differ. However, range safety regulations at CCAFS and VAFB prohibit launches when air dispersion models predict a toxic hazard to the public. Consequently, the public in and around VAFB is unlikely to be exposed to concentrations of emissions from launch vehicles that exceed allowable public exposure limits.

Based on information provided in SpaceX 2007, exhaust from the Merlin engines consists mainly of CO_2, CO, hydrogen, NOx, and water vapor. Trace amounts of other pollutants could be emitted during launch operations; however, these amounts would be anticipated to be minor and would disperse after launch.

Based on data provided by SpaceX (Sections 2.1.1.1 and 2.1.1.2 of this EA), the Falcon 9 launch vehicle has capacity for up to 35,000 gallons of RP-1 (kerosene) propellant; the Falcon 9 Heavy has capacity for up to 100,000 gallons of RP-1.

Based on the analysis for CCAFS, it is estimated that each launch would produce 95.22 tons of CO, and trace amounts of other pollutants. As discussed in Chapter 2, it is anticipated that at program maturity, up to 10 launches per year could occur from SLC-4E (five Falcon 9 and five Falcon 9 Heavy launches). The maximum emissions of CO are therefore likely to be up to 950.22 tons per year; however, only a small proportion of the emissions associated with each launch would have the potential to affect ambient air quality, which is defined as the area below the mixing height, typically 3,000 feet above ground level. According to data cited in SpaceX 2007, emissions per launch within 3,000 feet above ground level for a rocket propelled with LOX and RP-1 would be 1.2 tons of NOx and insignificant amounts of other pollutants.

In addition to emissions associated with launch activities, it is anticipated that each launch would result in vehicle trips due to workers required to support launch activities, and heavy duty truck trips associated with delivery of components, fuel and propellants. It was estimated that up to 100 local workers and 100 transient workers, for a total of 200 workers, could be involved in launch operations on a maximum daily basis. Based on the annual launch schedule, it was assumed that these workers would be commuting to the launch facility throughout the year. It is anticipated that approximately 6 truck trips would occur per week to deliver components, fuel, LOX, and helium, resulting in 312 trips annually. In addition, two emergency diesel generators would be installed for use for back-up power generation purposes. Each generator is anticipated to operate for a maximum of 336 hours per year, which would include back-up operations and any necessary maintenance activities.

Table 4-2 provides a summary of annual operational emissions associated with the operation of the Falcon 9 and Falcon 9 Heavy programs. Operational emissions for all pollutants are below the major source threshold of 100 tons per year for all criteria pollutants; therefore the Proposed Action

Table 4-2. Proposed Action operational emissions (tons/year).

	CO	VOCs	NO_x	SO_x	PM_{10}	$PM_{2.5}$
Falcon 9 and Falcon 9 Heavy Operations						
Employee Vehicles	13.99	0.79	1.47	0.01	0.08	0.08
Operations Delivery Trucks	0.14	0.03	0.48	0.00	0.02	0.02
Emergency Generators	0.48	0.18	2.23	0.15	0.16	0.16
Launch Emissions[1]	-	-	12	-	-	-
Total	***14.61***	***1.00***	***16.18***	***0.16***	***0.26***	***0.26***
Operational Significance Threshold	100	100	100	100	100	100
Exceeds Threshold?	No	No	No	No	No	No

Note:
1 Indicates estimated launch emissions within 3,000 feet above ground level; assuming 10 launches per year.

would result in less than significant impacts to air quality.

4.1.1.3 Greenhouse Gases and Global Climate Change

Emissions of GHG are considered to have a potential cumulative impact on global climate. The emissions associated with construction and operations under the Proposed Action would incrementally increase regional emissions of CO_2 and other GHG. Scientists are in general agreement that the Earth's climate is gradually changing, and that change is due, at least in part, to emissions of CO_2 and other GHG from manmade sources. The anticipated magnitude of global climate change is such that a significant cumulative impact on global climate exists.

On the issue of global climate change, however, there are no adopted federal plans, policies, regulations, or laws mandating reductions in the GHG emissions that cause global climate change. The climate change research community has not yet developed tools specifically intended to evaluate or quantify end-point impacts attributable to the emissions of GHG from a single source. In particular, because of the uncertainties involving the assessment of such emissions regionally and locally, the very minor and incremental contribution of the Proposed Action to climate change cannot be determined, given the current state of the science and assessment methodology.

This project would be indentified as a separate facility in accordance with facility definitions as found in 17 CCR §95102 and 40 CFR 98.6, as applicable to military installations. Accordingly, GHG emissions from the modifications to SLC-4E and operation of the Falcon 9 and Falcon 9 Heavy programs would be regulated separately.

To calculate emissions associated with the proposed project, emissions attributable to Scopes 1, 2, and 3, as defined in EO 13514, have been estimated. Scope 1 emissions include those emissions attributable to sources that are owned and operated by the Federal Government. These emissions would include emissions from stationary sources at the project site. Scope 1 GHG emissions are limited to emissions from emergency generators that would only be operated for testing purposes on a regular basis.

Scope 2 emissions include those emissions that are direct GHG emissions resulting from the generation of electricity, heat, or steam purchased by a federal agency. For the Proposed Action, it is not anticipated that Scope 2 emissions would be different from existing conditions.

Scope 3 emissions include GHG emissions from sources not owned or directly controlled by a federal agency but related to agency activities such as vendor supply chains, delivery services, and employee travel and commuting. For the Proposed Action, these GHG emissions include emissions associated with modifications made to SLC-4E, as well

as emissions from local and transient launch support workers and from the launches themselves.

Santa Barbara County has not yet adopted specific numeric thresholds with which to evaluate greenhouse gas emissions. VAFB has not yet adopted such thresholds, nor has VAFB developed a Climate Action Plan with which to evaluate the project's contribution. The Proposed Action's emissions have therefore been compared with the proposed federal threshold of 25,000 metric tons of CO_2e emissions.

Table 4-3 summarizes the annual GHG emissions associated with modifications made to SLC-4E and the operation of the Falcon 9 and Falcon 9 Heavy launch vehicle programs. Launch emissions were calculated based on RP-1 fuel use in gallons, using the California Climate Action Registry General Reporting Protocol emission factors (California Climate Action Registry 2009). Estimates of GHG emissions generated under the Proposed Action are presented in Appendix A. These data show that the annual CO_2e emissions estimated for the Proposed Action would be less than the proposed significance threshold of 25,000 metric tons of CO_2e. Therefore, cumulative impacts to global climate change would not be significant.

A final decision for assigning reporting responsibility of GHG emissions during modifications to SLC-4E and operation of the Falcon 9 and Falcon 9 Heavy programs, and responsibility for ensuring required reductions are met, would be made by the CARB, the SBCAPCD, and the Air Force prior to the start of any project activities and with full cooperation of regulatory agencies.

4.1.2 Environmental Protection and Minimization Measures

Implementation of the environmental protection and minimization measures outlined below should avoid or minimize potential adverse effects to air quality during implementation of the Proposed Action. These measures are considered integral elements of the project description, and would be fully implemented.

- Before any modifications to SLC-4E or construction begins for the Proposed Action, portable equipment meeting the criteria defined in the Final Regulation Order, effective September 12, 2007 for the California Portable Equipment Registration Program would be registered in the program or have a valid SBCAPCD Permit to Operate.

Table 4-3. Annual GHG emissions under the Proposed Action.

Scenario/Activity	Metric Tons per Year[1]			
	CO_2	CH_4	N_2O	CO_2e
Construction				
SLC-4E Modifications	1,099	0.11	0.37	1,212
Operations				
Transient Employee Vehicles	790	0.10	0.13	830
Emergency Generators	75	-	-	75
Operations Delivery Trucks	55	0.00	0.04	67
Launch Emissions	6,588	1.01	0.07	6,629
TOTAL	***7,508***	***1.22***	***0.61***	***8,813***
Proposed Significance Threshold	-	-	-	25,000
Above Threshold?	-	-	-	No

Notes:
1. $CO_2e = (CO_2 * 1) + (CH_4 * 21) + (N_2O * 296)$.

- Portable diesel equipment would comply with the Airborne Toxic Control Measure for Diesel Particulate Matter from Portable Engines Rated at 50 Horsepower and Greater, dated September 12, 2007.
- Equipment usage and fuel consumption would be documented and reported to the 30th Civil Engineer Squadron, Asset Management Flight (30 CES/CEA) to facilitate tracking construction emissions for inclusion in the VAFB Air Emissions Inventory.
- Idling of heavy-duty diesel trucks during loading and unloading would be limited to 5 minutes, with auxiliary power units used whenever possible.

Although significant emissions would not occur from the Proposed Action, the following SBCAPCD dust control measures would be implemented to further decrease fugitive dust emissions from ground disturbing activities:

- Water would be applied at least twice daily to dirt roads, graded areas, and dirt stockpiles to prevent excessive dust at the staging areas. Watering frequency would be increased whenever the wind speed exceeds 15 miles per hour (mph). Chlorinated water would not be allowed to run into any waterway.
- Vehicle speeds would be minimized on exposed earth.
- Ground disturbance would be limited to the smallest practical area and to the least amount of time.
- The SWPPP, including BMPs to reduce dust emissions, and the Environmental Protection Plan (EPP), which includes dust control compliance measures, would be implemented.
- If importation, exportation, and stockpiling of fill material are involved, soil stockpiled for more than 2 days would be covered, kept moist, or treated with soil binders to prevent dust generation. Trucks transporting fill material to and from the site would be tarped from the point of origin.

In addition to the above dust control measures, the following control measures would be implemented to decrease diesel emissions. Diesel engines operated in California are required to meet CARB established standards, which may be more stringent than federal mandates.

- Engine size in equipment used for the project would be minimized.
- The use of equipment would be managed to minimize the number of pieces of equipment operating simultaneously and total operation time for the project.
- Engines would be maintained in tune per manufacturer or operator specification.
- CARB-certified diesel fuel would be used.
- If feasible, U.S. EPA or CARB-certified diesel catalytic converters, diesel oxidation catalysts, and diesel particulate filters would be installed.
- CARB-developed idling regulations for trucks during loading and unloading would be followed.
- When applicable, equipment powered by diesel engines retrofitted or re-engined to meet the Air Toxics Control Measures for Off-Road Vehicles, would be used.

4.1.3 No-Action Alternative

Under the No-Action Alternative, the modifications to SLC-4E and operation of the Falcon 9 and Falcon 9 Heavy programs would not be implemented. No air emissions would be associated with the No-Action Alternative and there would be no impacts to air resources.

4.2 Biological Resources

Impacts to biological resources would occur if special status species (i.e., endangered, threatened, rare, or candidate) or their habitats, as designated by federal and state agencies, would be directly or indirectly affected by project related activities. In

addition, impacts to biological resources are considered adverse if substantial loss, reduction, degradation, disturbance, or fragmentation would occur in native species habitats or in their populations. These impacts can be short- or long-term impacts, such as short-term impacts from noise and dust during construction, and long-term impacts from the loss of vegetation and consequently, loss of the capacity of habitats to support wildlife populations.

4.2.1 Proposed Action

The Proposed Action would have the potential to result in short-term, temporary, adverse effects to biological resources within the overpressure zone, overflight zone, and in areas within 7.4 miles of SLC-4E, which may experience noise levels up to 100 dBA during Falcon 9 Heavy launches (Figure 3-1). Adverse effects in these areas would be limited to disturbance with no physical impacts to existing habitats or vegetation expected. Long-term, permanent effects are anticipated within the SLC-4E complex and within 30 ft of the exterior fence line due to SLC-4E modifications and the resumption of landscape maintenance practices.

Dragon capsules' soft-landing in the ocean would be preplanned, occur in the open ocean, and a salvage vessel would be positioned for recovery. Given the relatively low density of species within surface waters of open ocean areas it is unlikely that marine wildlife would be adversely affected by landing of a Dragon capsule. The residual propellant in the capsules (less than 50 gallons) would be contained in tanks, and is not anticipated to result in any spills. However, in the unlikely event of a spill the propellants are expected to dissipate rapidly given their volatile nature. The recovery vessel would be equipped with containment equipment for transporting the capsules and for off-loading residual propellants, if required.

Specific effects of implementing the Proposed Action on botanical and wildlife resources are discussed in more detail below, and potential related effects to special status species are summarized in Table 4-4. Measures to minimize or avoid adverse effects on natural resources and special status species during project implementation are summarized in Section 4.2.2, Environmental Protection and Minimization Measures.

Table 4-4. Potential Proposed Action related effects on special status species.

Common Name *Scientific Name*	**Status**		**Occurrence**	**Potential Effects**
	USFWS/ NOAA1	**CDFG2**		
Plants				
Beach layia *Layia carnosa*	FE		Documented	No adverse effects anticipated
Invertebrates				
Euphilotes battoides allyni El Segundo blue butterfly	FE		Potential	Loss of eggs, larvae, and pupae, and host plant seacliff buckwheat, and disruption of normal behavior
Fish				
Tidewater goby *Eucyclogobius newberryi*	FE		Potential	No adverse effects anticipated
Amphibians				
California red-legged frog *Rana draytonii*	FT	SSC	Documented	Temporary disruption of normal behavior due to noise
Birds				
California least tern *Sterna antillarum browni*	FE	SE, FP	Potential	Temporary disruption of normal behavior due to noise

Common Name *Scientific Name*	Status		Occurrence	Potential Effects
	USFWS/ NOAA1	CDFG2		
Western snowy plover *Charadrius alexandrinus nivosus*	FT, BCC	SSC	Documented	No adverse effects anticipated
California brown pelican *Pelecanus occidentalis californicus*	FD	SD	Documented	Temporary disruption of normal behavior due to noise
American peregrine falcon *Falco peregrinus anatum*	FD, BCC	SD, FP	Documented	Temporary disruption of normal behavior due to noise
Bald eagle *Haliaeetus leucocephalus*	BGEPA, FD	SE	Potential	Temporary disruption of normal behavior due to noise
Golden eagle *Aquila chrysaetos*	BGEPA	FP	Documented	Temporary disruption of normal behavior due to noise
Mountain plover (wintering) *Charadrius montanus*	BCC	SSC	Documented	No adverse effects anticipated
Black oystercatcher (nesting) *Haematopus bachmani*	BCC		Documented	Temporary disruption of normal behavior due to noise
Whimbrel *Numenius phaeopus*	BCC		Documented	Temporary disruption of normal behavior due to noise
Long-billed curlew *Numenius americanus*	BCC		Documented	Temporary disruption of normal behavior due to noise
Marbled godwit *Limosa fedoa*	BCC		Documented	Temporary disruption of normal behavior due to noise
Western burrowing owl *Athene cunicularia hypugea*	BCC	SSC	Documented	Temporary disruption of normal behavior due to noise
Allen's hummingbird (nesting) *Selasphorus sasin*	BCC		Documented	Temporary disruption of normal behavior due to noise, loss nests/nesting habitat
Nuttall's woodpecker (nesting) *Picoides nuttallii*	BCC		Documented	Temporary disruption of normal behavior due to noise
Loggerhead shrike (nesting) *Lanius ludovicianus*	BCC	SSC	Documented	Temporary disruption of normal behavior due to noise
Oak titmouse (nesting) *Baeolophus inornatus*	BCC			Temporary disruption of normal behavior due to noise
Yellow warbler (nesting) *Dendroica petechia brewsteri*	BCC			Temporary disruption of normal behavior due to noise
Tricolored blackbird (nesting colony) *Agelaius tricolor*	BCC	SSC		Temporary disruption of normal behavior due to noise
Lawrence's goldfinch (nesting) *Carduelis lawrencei*	BCC			Temporary disruption of normal behavior due to noise, loss nests/nesting habitat
Mammals				
Southern sea otter *Enhydris lutris neris*	FT	SSC, FP	Documented	Temporary disruption of normal behavior due to noise
Pacific harbor seal *Phoca vitulina richardi*	MMPA		Documented	Temporary disruption of normal behavior due to noise
California sea lion *Zalophus californianus*	MMPA		Documented	Temporary disruption of normal behavior due to noise
Northern elephant seals *Mirounga angustirostris*	MMPA		Documented	Temporary disruption of normal behavior due to noise
Northern fur seal *Callorhinus ursinus*	MMPA		Documented	Temporary disruption of normal behavior due to noise

Notes:
1 FE = Federal Endangered Species FT = Federal Threatened Species FD = Federal Delisted Species BCC = Federal Bird of Conservation Concern BGEPA = Bald and Golden Eagle Protection Act MMPA = Marine Mammal Protection Act
2 CDFG = California Department of Fish and Game SE = California Endangered Species SD = State Delisted Species SSC = California Species of Special Concern FP = California Fully Protected Species

4.2.1.1 Botanical Resources

Potential effects to vegetation types and plant species within SLC-4E include:

- Short-term (temporary) and long-term (permanent) loss of habitat from construction related activities such as access, excavation, and building of structures
- Loss of individuals within project areas due to excavation, crushing, or burial
- Loss of individuals in habitats adjacent to work areas due to soil erosion
- Loss of shrubs and a decline in perennial species due to mowing

The Proposed Action has the potential to affect approximately 0.04 acres of ESBB habitat, 57.9 acres of NNG, and 1.8 acres of CCS/NNG. Little change in net vegetation cover is expected within SLC-4E as a result of construction; however, the resumption of regular mowing and vegetation management practices would likely lead to the conversion of all or part of the mixed CCS/NNG vegetation type to NNG. Mowing would also favor the establishment of annual species or quick maturing perennials that can cope with disturbance and set seed rapidly. Thus, anticipated effects on botanical resources would be less than significant.

4.2.1.2 Wildlife Species

Potential effects to wildlife species associated with the Proposed Action include:

- Long-term loss of habitat and loss of individuals within the construction area and the area of resumed landscape maintenance
- Loss of individuals within the construction and the landscape maintenance area due to excavation, crushing, or burial
- Short-term (temporary) disruption of normal behavior due to noise within the 100 dBA area
- Disruption of foraging or roosting activities due to noise and associated disturbance within the 100 dBA area

Wildlife, including mammals, amphibians, reptiles, and birds, present in the vicinity of project activities could be affected by project-generated noise. Wildlife response to noise can be physiological or behavioral. Physiological responses can range from mild, such as an increase in heart rate, to more damaging effects on metabolism and hormone balance. Behavioral responses to manmade noise include attraction, tolerance, and aversion. Each has the potential for negative and positive effects, which vary among species and individuals of a particular species, due to temperament, sex, age, and prior experience with noise. Responses to noise are species-specific; therefore, it is not possible to make exact predictions about hearing thresholds of a particular species based on data from another species, even those with similar hearing patterns.

Potential impacts to wildlife species from human presence, project-generated noise, and disturbance associated with project implementation include temporary disruption of foraging and roosting activities and loss of habitat. Wildlife species would be expected to move away from the areas of disturbance during construction activities. Depending on distance and species, wildlife may flee, freeze, or show no reaction to noise produced as a result of Falcon 9 and Falcon 9 Heavy launches. These disturbances would be considered short-term and temporary, and would not be considered of a magnitude to result in adverse impacts to populations within the vicinity of the project area. Additionally, the Falcon 9 and Falcon 9 Heavy vehicles would be smaller and quieter than those previously launched from SLC-4E under the Titan IV launch program. Therefore, adverse effects on wildlife species would be less than significant.

The Migratory Bird Treaty Act provides federal protection to native avian species, their nests, eggs, and unfledged young. The initial removal of woody vegetation within the landscape maintenance area would be conducted outside of the March to August 15 breeding season for most migratory bird species to minimize impacts to nesting birds.

4.2.1.3 Federal ESA Listed Species

Formal section 7 consultation with the USFWS for federally listed species with potential to be affected was completed on 10 December 2010 and updated on 24 June 2011. The completed consultation was in the form of two Biological Opinions (8-8-10-F-38 (USFWS 2010) and 8-8-11-F-32R (USFWS 2011)). The USFWS determined that the Proposed Action may affect, is not likely to adversely affect the California least tern, southern sea otter, western snowy plover, and California red-legged frog. The USFWS determined that the Proposed Action is not likely to jeopardize the continued existence of the El Segundo blue butterfly and issued the Air Force and Incidental Take Statement for that species. VAFB will ensure that all terms and conditions stipulated within the Biological Opinions are implemented.

Formal section 7 consultation with NOAA Fisheries Services is not required for the Proposed Action, as the Falcon vehicle was included under the 5-year Permit. Additionally, the LOA (NOAA Fisheries Service 2010) includes the Falcon family of launch vehicles, and monitoring measures are in place for species protected under the MMPA.

Beach Layia

There is no suitable beach layia habitat in areas that would be impacted by construction or landscape maintenance activities, or within the overpressure zone. No deposition of harmful chemicals is anticipated as a result of planned launch activities. Occupied beach layia habitat within the overflight zone totals 11.4 ft^2. In the unlikely event of a launch related fire escaping the 300-ft overpressure zone, both Surf Road and Coast Road would serve as firebreaks between occupied beach layia habitat and SLC-4E. For this reason the Proposed Action would not affect beach layia.

El Segundo Blue Butterfly

At this time VAFB, USFWS, and ESBB experts are attempting to better quantify habitat descriptors used to define ESBB potential habitat. Based on available information, it is reasonable to assume that ESBB do not inhabit every seacliff buckwheat plant on VAFB; additionally because the range of seacliff buckwheat far exceeds the range of the ESBB, it is highly unlikely that all areas supporting seacliff buckwheat can be considered potential habitat.

Seacliff buckwheat plants within the SLC-4E complex may be lost during construction and the resumption of landscape maintenance practices. The destruction or damage of buckwheat plants during the June through September period when eggs or larvae may be present could result in mortality of these life stages. Adults may suffer direct mortality from vehicle strikes, from traffic on roads and in parking lots, and from tractors used to perform landscape maintenance during their mid-June through August activity period. Sustained activity during the adult flight season may also disrupt normal behavior such as feeding and breeding. Vehicle traffic and other activities causing soil compaction, especially in proximity to seacliff buckwheat, have potential to crush diapausing pupae.

Although seacliff buckwheat densities have never been quantified within occupied ESBB habitat, observed densities within the SLC-4E complex and the CCS of the overpressure zone appear to be much lower. In addition, most plants are small and widely scattered. These areas likely only represent marginal ESBB habitat. Although areas supporting high densities of seacliff buckwheat do occur within the overflight zone, ESBB have never been documented in these areas.

Due to the relatively small size of habitat within the project area (0.4 acres) where impacts would occur, the extensive distribution of buckwheat on VAFB, the minimization and monitoring measures proposed (Section 4.2.2), and the fact that ESBB have not been documented within known dispersal distance of the project area, adverse effects on ESBB and its habitat are anticipated to be less than significant.

Tidewater Goby

The Proposed Action would have no effect on the tidewater goby. All occupied tidewater goby habitat is outside of the overpressure and overflight zone. There are numerous paved roads, fire breaks and fire access roads between potential habitat in Honda Creek and the overpressure zone that would act as readily defensible barriers in the event of a launch related fire. Additionally, no toxic chemical deposition would occur as a result of planned project activities. The Proposed Action would result in no impacts to water quality at potential habitat in Cañada Honda Creek.

California Red-legged Frog

The Proposed Action may affect, but is not likely to adversely affect CRLFs. Maintenance of the retention basin will be such that it will not be suitable for CRLF occupancy. SLC-4E is also over 1 mile from the nearest documented CRLF locality, and open areas within the interior of the complex are inconsistent with CRLF upland habitat.

If water is permitted by the RWQCB to be discharged to grade, it would not be directly discharged to Spring Creek. Discharges would take place within the SLC-4E complex and water would be allowed to infiltrate into the groundwater. The presence of this additional moisture is unlikely to significantly alter the amount of surface water seasonally present within Spring Creek. No toxic chemical deposition would occur as a result of planned project activities.

Within the overflight zone, CRLF have been documented in Honda Creek and in the vicinity of SLC-6. CRLF are widely distributed within areas that may be impacted by launch noise in excess of 100 dBA. This noise may elicit a startle or freezing response from frogs which would cause them to flee to water or attempt to hide in place. Noise could also mask biologically significant sound such as predators, mask courtship calls, or trigger a temporary cessation of calling. Sustained noise at high levels could also result in temporary or permanent hearing damage (this is, however, highly unlikely given the short duration of launch noise, approximately 5 minutes).

CRLF monitoring, consisting of pre- and post-launch counts and observations, was conducted within Bear Creek pursuant to monitoring requirements for the 8 September 2001 launch of an Atlas IIAS MLV-10 from SLC-3E. The launch site is approximately 1.5 miles from where CRLF were observed. Post-launch counts were within the range of pre-launch counts and no evidence of mortality, injury or abnormal behavior was observed in CRLF after the launch (SRS Technologies 2001b).

Due to the fact that launch related noise will be of short duration, the distance of CRLF localities from the launch site and the ability of water to buffer sound, damage to CRLF hearing is highly unlikely, and any disruption of CRLF behaviors would be of short duration and temporary. Additionally, past monitoring of CRLF response to a launch did not document any adverse effects.

California Least Tern

CLTE foraging and breeding areas are not within overflight zone of the Falcon 9 and Falcon 9 Heavy launch vehicles. However, because CLTE foraging areas are within the 100 dBA area, they could be affected by launch related noise.

Monitoring of CLTE has been conducted for four Delta II launches from SLC-2. CLTE response had been mixed. Pre- and post-launch monitoring of non-breeding CLTE during the 7 June 2007 Delta II COSMO-1 launch, and nesting CLTE during the 20 June 2008 Delta II OSTM launch did not document any mortality of adults, young or eggs, or any abnormal behavior following the launches (MSRS 2007a, 2008c). The May and July 1997 launches of Delta IIs were, however, determined to have potentially caused the abandonment of up to five nests and the death of a chick due to exposure. Definitively attributing these losses to launch related disturbance was not possible due to nightly predation attempts by both great horned and

barn owls. Predation of adult CLTE may have been responsible for some of the losses observed (BioResources 1997).

To date no launches originating from South Base have occurred during CLTE nesting season for which a monitoring requirement has been in place. It is unknown how nesting CLTE would respond to a launch from SLC-4E. However, given the distance from SLC-4E and the overflight zone to the CLTE nesting area on VAFB, it is unlikely that launch related noise would alter their behavior at that site. The Santa Ynez River area (3.7 miles north) that is occasionally used for foraging, may receive a significant amount of noise that could briefly affect foraging behavior. These effects would be short-term and temporary and would be less than significant. The proposed monitoring measures (see Section 4.2.2) are, however, in place to verify that this will be the case.

Western Snowy Plover

WSPL habitat does not occur within the overflight zone of the Falcon 9 and Falcon 9 Heavy launch vehicles. There are numerous paved roads, fire breaks and fire access roads between WSPL habitat and the overpressure zone that would act as readily defensible barriers in the event of a launch related fire.

WSPL may experience launch related noise in excess of 100 dBA. Monitoring of WSPL has been conducted during numerous past launches. Direct observation of wintering birds was made during a Titan IV launch from SLC-4E; the Titan IV represents a larger, louder (130 dBA) launch vehicle than the Falcon 9 and Falcon 9 Heavy. WSPL did not exhibit any adverse reactions to the launch (SRS Technologies 2006d). Additionally, monitoring of WSPL during the breeding and non-breeding season for other launches has demonstrated that WSPL behavior is not adversely affected by launch noise or vibrations, and no injury or mortality to adults, young, or eggs has been documented following any of the launches (SRS Technologies 2006a, 2006b, 2006c, 2006e, 2006f, 2006g, 2006h; MSRS 2007a, 2008b, 2008c, 2009e). Monitoring consisted of pre- and post-launch counts as well as video or direct monitoring of behavior of both nesting and wintering birds where required. Given the vast amount of information available on the response of WSPL to space vehicle launches, it is anticipated that the Proposed Action would have no significant adverse effects on WSPL.

Southern Sea Otter

Southern sea otters occur offshore west of the Sudden Flats area on south VAFB, which is within the 100 dBA zone but outside the overflight zone for the Falcon 9 and Falcon 9 Heavy launch vehicles. Sea otters may briefly startle in response to visual and auditory stimuli originating from the space vehicle launches. Launch monitoring of sea otters on both north and south VAFB has been extensive. Pre- and post-launch counts and observations have been conducted at rafting sites immediately south of Purisima Point for numerous Delta II launches from SLC-2, and one Taurus launch from SLC-576 (Taurus launch site), and at the rafting sites off of Sudden Flats for two Delta IV launches from SLC-6. No mortality, injury or abnormal behavior has ever been documented as a result of launch related disturbance (SRS Technologies 2006a, 2006b 2006c, 2006f, 2006g, 2006h, 2006i, 2007; MSRS 2007a, 2007b, 2008a, 2008c, 2008d, 2008e, 2009a, 2009b, 2009c, 2010a). For this reason, it is anticipated that adverse effects to sea otters as a result of the Proposed Action are unlikely and if they occur, they would be less than significant.

4.2.1.4 Species Protected Under the Marine Mammal Protection Act

Pacific harbor seals on VAFB may experience launch noise in excess of 100 dBA, and pinnipeds on the NCI may be exposed to sonic booms resulting from launches. Launch related disturbance, both visual and auditory, has the potential to elicit a flight response, during which seals would flee to the water, with the potential to result in injury and death if pups are present, as they would be subject

to trampling by adults fleeing to the water, or abandonment.

The LOA issued to VAFB establishes required monitoring of select pinniped species on VAFB and the NCI to document their behavioral response and other adverse effects as a result of launch noise and sonic booms. Given the extensive number of launches for which monitoring has been completed at VAFB and the NCI, where significant adverse effects have not been documented, it is anticipated that the Proposed Action would not result in significant adverse effects.

4.2.1.5 Other Special Status Species

Impacts on avian species with potential to use areas affected by the SLC-4E modifications and resumption of landscape maintenance practices, would be minimized by conducting the initial clearing of brush outside of the breeding season (March – August 15).

Numerous defensible barriers are in place to prevent the spread of fire beyond the SLC-4E complex and overpressure zone. Launch related noise may affect special status bird species. The degree of disturbance would depend on a variety of factors such as hearing acuity, species, and distance. If a nesting bird is startled to the degree that it flees the nest, this could potentially result in damage to eggs or young, as well as leave eggs and young vulnerable to environmental conditions.

Launches of the magnitude of those proposed from SLC-4E are not a new occurrence on VAFB, and the Falcon 9 and Falcon 9 Heavy launch vehicles would be smaller and quieter than those previously launched from SLC-4E. Landscape maintenance activities proposed under the Proposed Action are also consistent with past land use practices at SLC-4E. Therefore, it is anticipated that any adverse effects resulting from the Proposed Action would likely be associated with temporary disturbances, and would be less than significant.

4.2.2 Environmental Protection and Minimization Measures

Implementation of the environmental protection and minimization measures outlined below should avoid or minimize potential adverse effects to biological resources during implementation of the Proposed Action. These measures are considered integral elements of the project description, and would be fully implemented.

In the event that an unexpected launch fire spread further than 30 ft from the outer perimeter fence of SLC-4E into special status species habitat, surveys would be conducted to assess potential impacts to special status species and habitat. If it is determined that special status species or habitat may have been adversely affected, an appropriate monitoring or mitigation program would be devised through consultation with USFWS.

Minimization and monitoring measures for the federally endangered ESBB and CLTE would be implemented to reduce and/or characterize the effects of planned project activities.

To be exempt from the prohibitions of Section 9 of the ESA, the following term and condition as listed in the Biological Opinion would be fully implemented.

El Segundo Blue Butterfly

- A flight season ESBB survey by a USFWS permitted biologist would be conducted within the project area to determine if ESBB are present.
- Areas with seacliff buckwheat would be flagged and avoided, including a 2-ft buffer around each plant, as long as avoidance of the plant(s) does not preclude program operation needs.
- A biological monitor will be on-site to help ensure the adverse effects to seacliff buckwheat plants are minimized.
- Seacliff buckwheat that is damaged or destroyed would be replaced on a 1:5 basis at an ESBB restoration site on VAFB, to be designated by a VAFB biologist.

- If more than 0.4 acre of seacliff buckwheat plants are damaged or destroyed within SLC-4E due to program activities, any operations causing such take must cease pending reinitiation of the consultation with the USFWS.

California Least Tern

- Monitoring of nesting CLTE at the Santa Ynez River estuary and the Purisima Point breeding site would be conducted to determine impacts from launches for the first launch of a Falcon 9 and a Falcon 9 Heavy space vehicle from SLC-4E when CLTE are present. A USFWS approved biologist would conduct population censuses up to 3 days before the launch, monitor behavior during the launch for daytime launches (if feasible), and conduct population censuses and note any mortality, injury or abnormal behavior for up to 3 days following the launch (USFWS 1997).

- If adverse effects are documented or results of monitoring are inconclusive, monitoring would continue for subsequent launches until the nature of effects could be accurately determined.

Nesting Birds

- Vegetation clearing involving the removal of shrubs or trees would take place outside of the March through August 15 nesting period to minimize impacts to nesting native birds, as long as it does not jeopardize fire suppression, security requirements, or program operation needs.

- Appropriate exclusionary measures would be put in place prior to March 15 to prevent the establishment of bird nests in or on structures where nests would conflict with program operation needs.

- Removal of nest structures would take place after young have fledged or after August 15, when the breeding season has concluded for most species, to the degree that it does not jeopardize fire suppression, security requirements, or program operation needs.

- If removal of nests of avian species protected under the Migratory Bird Treaty Act is necessary during the March 15 – August 15, when young may be present, to meet fire suppression, security requirements, or program operation needs, nests would be checked for unfledged young and if found, young would be transferred to an appropriate wildlife rehabilitation organization for rearing and release.

Pinnipeds

Per the LOA, the following monitoring would be completed for pinniped species protected under the MMPA.

- Pacific harbor seals would be monitored at the south VAFB haul out sites during the pupping season, March 1 – June 30. Surveys would be conducted starting 72 hours prior to launch and continue through 48 hours after the launch. For daytime launches, video recording of mother-pup pairs would be accomplished.

- Modeling would be conducted to predict the area of impact of sonic booms. If a sonic boom greater than 1 psf is predicted to impact the NCI, pinnipeds would be monitored on the affected NCI starting 72 hours prior to the launch and continuing through 48 hours after the launch. Additionally, the sonic boom would be acoustically recorded on the NCI.

Other Measures for Protection of Biological Resources

- All human generated trash with the SLC-4E project area would be contained and removed from the work site and properly disposed of on a frequent basis. All construction debris and trash would be removed from the project area upon completion of the project.

- Appropriate erosion, sediment, and water runoff control measures would be used during construction.

4.2.3 No-Action Alternative

Under the No-Action Alternative, the modifications to SLC-4E and operation of the Falcon 9 and Falcon 9 Heavy programs would

not be implemented. Thus, biological resources would not be affected.

4.3 Cultural Resources

The Proposed Action is subject to compliance with all relevant authorities governing cultural resources, including Section 106 of the NHPA and AFI 32-7065, Cultural Resources Management. Compliance with Section 106 of the NHPA also satisfies federal agencies responsibilities for considering potential project related effects to historic properties under the NEPA. Section 106 of the NHPA requires federal agencies to consider the effects of proposed federal undertakings on historic properties that are listed in or eligible for listing in the NRHP (a.k.a. historic properties). Part of compliance with Section 106 requires the federal agency to determine either that the undertaking would have no effect to historic properties, no adverse effect to historic properties, or an adverse effect to historic properties (which would then require resolving). The Section 106 implementing regulations [36 CFR Part 800] prescribe the process for making these determinations.

4.3.1 Proposed Action

Archaeological site complex CA-SBA-537/1816 extends slightly into SLC-4E and isolated artifact VAFB-ISO-300 is recorded within the launch complex. The exact recorded location of VAFB-ISO-300 is unknown; its plotted location is within the substantially modified part of SLC-4E. Given the amount of earthmoving required to construct the launch facility and the proximity of archaeological sites outside the launch complex, it is likely that the isolated artifact represents a secondary deposit. Isolated artifacts have no regulatory status and management of VAFB-ISO-300 is not necessary.

Both CA-SBA-537 and -1816 were formally determined eligible for the NRHP by the Air Force in the late 1980s, and the SHPO concurred with that determination. Extensive data recovery excavations were completed at the sites in conjunction with repairs and restoration of SLC-4. Applied EarthWorks' subsurface testing at CA-SBA-537/1816 within the launch complex found not only poor integrity, but also that the portion of the site within the launch complex was manifest as a low density and low diversity deposit (Lebow et al. 2005). They proposed—and VAFB and the SHPO subsequently concurred—that demolition of buildings within SLC-4 would not adversely affect the site complex.

As part of the Section 106 compliance study for the proposed project, Lebow (2010) follows the analysis by Lebow et al. (2005:6.22–6.23) and opines that the small portion of CA-SBA-537/1816 within SLC-4E lacks the qualities that make it eligible for the NRHP. Consequently, the site complex would not be adversely affected by the modifications to SLC-4E or the Falcon 9 and Falcon 9 Heavy program operations. VAFB reviewed the Section 106 compliance study and determined that the proposed project would have no adverse effects. The California SHPO concurred with this finding on November 16, 2010 (OHP file reference # USAF100915A).

4.3.2 Environmental Protection and Minimization Measures

In the event that an unexpected launch fire caused damage to any cultural or historical properties, SpaceX would coordinate and work with the 30 CES/CEA to assess potential impacts to resources and coordinate with regulatory agencies if required.

4.3.3 No-Action Alternative

Under the No-Action Alternative, the modifications to SLC-4E and operation of the Falcon 9 and Falcon 9 Heavy programs would not be implemented; therefore no consequences for cultural resources would result.

4.4 Hazardous Materials and Waste Management

Potential impacts as a result of hazardous materials and waste are evaluated using federal, state, and local laws and regulations, contract specifications, and Base operating constraints, as outlined in Chapter 3, Section 3.4 of this EA. Hazardous materials management requirements are found in federal and state EPA and OSHA regulations, contract specifications and the VAFB *Hazardous Materials Management Plan*, 30 SWP 32-7086. Hazardous waste management requirements are found in federal, state, and local laws and regulations, contract specifications and the VAFB *Hazardous Waste Management Plan*, 30 SWP 32-7043A. Non-compliance with applicable regulatory requirements, human exposure to hazardous materials and wastes, or environmental release above permitted limits, would be considered adverse impacts.

4.4.1 Proposed Action

Compliance with all applicable federal, state, and local laws and regulations, and applicable VAFB plans, would govern all actions associated with implementing the Proposed Action, and should minimize the potential for adverse effects. Hazardous materials and waste management regulations required by federal, state, and local laws and regulations, and procedures outlined in the VAFB *Hazardous Materials Management Plan*, 30 SWP 32-7086, and VAFB *Hazardous Waste Management Plan*, 30 SWP 32-7043A, would be followed. These hazardous materials and wastes would be the same types as currently used and managed on VAFB during construction activities and launch operations (such as POLs, LOX, RP-1, etc). Thus, impacts to hazardous materials and waste management would be less than significant.

Installation Restoration Program

Because SLC-4E modification activities would occur within the boundaries of IRP Site 8, there is the potential for workers to encounter pollutants during implementation of the Proposed Action, as well as inadvertent interaction with IRP equipment and operations. Exposure to contamination would occur if groundwater or contaminated soil was encountered during excavation activities. However, as excavation would not exceed 16 ft below grade, groundwater is not anticipated to be encountered. Existing monitoring and injection wells would be avoided and surface soil contaminated with perchlorate would remain undisturbed to avoid impacts to ongoing remediation at the site. Any infrastructure modifications and operations at SLC-4E would accommodate for on-going IRP Site 8 monitoring and remediation activities, including access to groundwater monitoring wells, access to injection wells for remediation system operations and maintenance, and eventual proper abandonment/destruction of select monitoring wells and injection wells.

To avoid adverse effects and exposure of workers to contamination, coordination with the 30th Civil Engineer Asset Management Flight, Environmental Restoration (30 CES/CEANR) office would be required prior to the start of any refurbishment activities under the Proposed Action. If a fragment of perchlorate is encountered during construction activities, the 30 CES/CEANR would be contacted. Additionally, all site workers must be HAZWOPER trained.

4.4.2 Environmental Protection and Minimization Measures

Potential adverse impacts to the environment associated with hazardous materials and waste management should be minimized through strict compliance with all applicable federal, state, and local laws and regulations, local support plans and instructions including 30 SWP 32-7086, *Hazardous Materials Management Plan*; and 30 SWP 32-7043A, *Hazardous Waste Management Plan*, as well as those plans discussed in Chapter 3, Section 3.4. Implementing the measures presented below would further minimize the potential for adverse impacts during the

modifications to SLC-4E and during operations of the Falcon 9 and Falcon 9 Heavy programs. These measures are considered integral elements of the project description, and would be fully implemented.

- As applicable and required by the Air Force, hazardous materials may be required to be procured through or approved for use by the 30th Civil Engineer Squadron, Asset Management Flight, Pollution Prevention and Sustainment Office (30 CES/CEANP).
- All hazardous materials required to operate and maintain construction equipment, or used during launch operations, would be properly identified and used in accordance with manufacturer's specifications to avoid accidental exposure or release.
- Standard procedures would be used to ensure that all equipment and holding tanks are maintained properly and free of leaks during operation, and that all necessary maintenance or repairs are carried out in pre-designated controlled, paved areas to minimize risks from accidental spillage or release. A Spill Prevention Control and Countermeasures Plan would be submitted to 30 CES/CEA for approval.
- Hazardous materials, and hazardous waste generated during SLC-4E modification or Falcon 9 and Falcon 9 Heavy operations would be properly contained, stored and managed in secured areas, and disposed of in accordance with requirements.
- Proper disposal of hazardous waste would be accomplished through identification, characterization, sampling and analysis of wastes generated.
- Chemical stockpile spill containment, if necessary, would be accomplished to minimize or preclude hazardous releases.
- Workers on site would be trained for Hazardous Waste Operations and Emergency Response (HAZWOPER), as appropriate.

For demolition of existing facilities the following measures would also be implemented:

- In compliance with California Business Plan requirements, SpaceX would submit a Business Plan or Disclaimer based upon amount of hazardous materials present on site for more than 30 days.
- Per VAFB requirements, SpaceX would submit an EPP to the 30 CES/CEA prior to the start of demolition activities.

4.4.3 No-Action Alternative

Under the No-Action Alternative, the modifications to SLC-4E and operation of the Falcon 9 and Falcon 9 Heavy programs would not be implemented. Therefore, there would be no change in the management or levels of hazardous materials and waste.

4.5 Human Health and Safety

Potential adverse effects to human health and safety could occur during modification of SLC-4E, as well as during operations conducted under the Falcon 9 and Falcon 9 Heavy launch vehicle programs, as discussed below.

4.5.1 Proposed Action

Compliance with OSHA regulations and other recognized standards would be implemented during both the modification and operational phases of the Proposed Action. A health and safety plan would be developed and a formally-trained individual would be appointed to act as safety officer. The appointed individual would be the point of contact on all problems involving job site safety.

4.5.1.1 Modification of SLC-4E

During modification of SLC-4E, the contractor would comply with OSHA, AFOSH regulations, and other recognized standards and applicable Air Force regulations or instructions prescribed for the control and safety of personnel and visitors to the job site. Therefore, human health and safety would not be adversely impacted by general construction related hazards.

With the implementation of the environmental protection and minimization measures outlined in Section 4.5.2, potential health risks to project personnel and the public should be minimal, if any.

Potential Hazards

Physical hazards typical of any outdoor environment, including holes or ditches, uneven terrain, sharp or protruding objects, slippery soils or mud, and biological hazards including vegetation (i.e. poison oak and stinging nettle), animals (i.e. insects, spiders, and snakes), and disease vectors (i.e. ticks and rodents), exist at and near the proposed project area, and have the potential to adversely impact the health and safety of project personnel during modifications to SLC-4E. Adherence to federal OSHA regulations should minimize the exposure of workers to these hazards.

Unexploded Ordnance

Special precautions need to be taken in certain areas of VAFB that were used as practice ranges for artillery firing, referred to as areas of potential UXO. Coordination with the EOD Flight prior to the start of modifications under the Proposed Action should ensure no adverse effects on human health and safety occur.

Noise

According to regulations of the federal OSHA, employees should not be subjected to sound exceeding a L_{eq1H} of 90 dB for an 8-hour period. This sound level increases by 5 dB with each halving of time (e.g., 4-hour period at 95 dB). Exposure up to a L_{eq1H} of 115 dB is permitted for a maximum of only 15 minutes during an 8-hour workday and no exposure above 115 dB is permitted. For this analysis, OSHA standards are used as the "not to exceed" criteria as they are the most appropriate standards available.

Construction activities under the Proposed Action would temporarily increase the ambient noise levels within the proposed project area and in neighboring areas during project implementation activities. Relatively continuous noise would be generated by construction equipment. These continuous noise levels are generated from equipment that have source levels (at 3.28 ft) ranging from approximately 72.7 to 112.7 dB. As a sound source gets further away, the sound level decreases. This is called the attenuation rate. These rates are highly dependent on the terrain over which the sound is passing and the characteristics of the medium in which it is propagating. The rate used in these estimates was a decrease in level of 4.5 dB per doubling of distance. This average rate has been shown to be an accurate estimate from field data on grassy surfaces (Harris 1998). At 164 ft, these levels range from 47.3 to 87.3 dB. Adverse effects as a result of construction noise are expected to be minimal and less than significant.

4.5.1.2 Falcon 9 and Falcon 9 Heavy Operations

Regional and On-Base Safety

As described in Sections 3.5.1 and 3.5.2, 30 SW/SE reviews, approves, and monitors all pre-launch and launch operations in accordance with AFSPCMAN 91-710 to ensure that the public, launch area personnel, foreign land masses, and launch area resources are provided with an acceptable level of safety and that all launch operations adhere to public laws.

SpaceX would complete a PFDP for review and approval by 30 SW/SE prior to each Falcon 9 or Falcon 9 Heavy program launch to ensure compliance with all applicable health and safety rules and regulations.

Noise

Under the Proposed Action, operational noise would be intermittent. Noise generated during program operations is discussed in terms of launch noise and sonic boom impacts. In addition to the permissible noise exposure allowed under OSHA regulations and discussed above, regulations state that exposure to impulsive or impact noise should not exceed a 140 dB peak sound pressure level.

Acoustic levels versus distance from plume were modeled for the Falcon 9 and Falcon 9 Heavy launch vehicles (SpaceX 2010). Table 4-5 provides overall sound pressure levels (OASPL) versus distance for both vehicles. Levels do not include attenuation due to atmospheric absorption, nor noise suppression from the water deluge system. Recent ground acoustic levels modeling completed for the Falcon 9 and Falcon 9 Heavy indicate that sound pressure levels fall below 100 dBA at 5.3 miles from the launch site for the Falcon 9, and 7.4 miles for the Falcon 9 Heavy (SpaceX 2010).

Noise levels at the launch site are directly correlated to the thrust of the space launch vehicle at lift-off. Thrust levels for the Falcon 9 and the Falcon 9 Heavy are approximately 1.0 and 2.5 million pounds force (Mlbf) respectively (SpaceX pers. comm.). The Titan IV B-12 thrust level was 3.3 Mlbf (SpaceX, pers. comm.). Noise levels at SLC-4E during Titan IV launches were modeled (including attenuation factors) and were predicted to reach approximately 170 dB around the launch pad (USAF 1988).

Acoustic overpressures from the Titan IV launch at a distance between 100 and 200 ft from the launch vehicle were predicted to be equivalent to approximately 172 to 160 dB respectively (USAF 1988). Modeled noise levels at 125 ft for the Falcon 9 and Falcon 9 Heavy vehicles are predicted to be less than this, at 156.1 and 160.9 dB, respectively (SpaceX 2010). Hearing protection would be required for workers at the pad during a launch to ensure noise levels were reduced to below 115 dBA.

At 1.8 miles (approximately 9,500 ft) from the pad, noise from a Titan IV launch was predicted to be 119 dBA (USAF 1988), while modeled Falcon 9 and Falcon 9 Heavy noise

Table 4-5. Modeled engine noise levels for the Falcon 9 and Falcon 9 Heavy launch vehicles.

Distance (ft)	Falcon 9		Falcon 9 Heavy	
	Unweighted OASPL (dB)[1] ± 4.9 dB	A-weighted OASPL (dB)[1] ± 4.9 dB	Unweighted OASPL (dB)[1] ± 4.9 dB	A-weighted OASPL (dB)[1] ± 4.9 dB
125	156.1	149.0	160.9	149.6
500	146.7	135.6	151.5	141.9
1,000 (0.2 mile)	139.2	129.3	144.0	134.5
1.500	134.9	125.6	139.7	130.2
2,000	132.0	123.1	136.8	127.3
2,500 (0.5 mile)	129.8	121.1	134.5	125.0
3,000	128.0	119.5	132.7	123.2
3,500	126.5	118.1	131.2	121.7
4,000	125.2	116.9	130.0	120.4
4,500	124.1	115.9	128.8	119.3
5,000	123.1	115.0	127.9	118.3
5,500 (1.0 mile)	122.2	114.2	127.0	117.4
6,000	121.4	113.4	126.2	116.6
6,500	120.6	112.7	125.4	115.9
7,000	120.0	112.0	124.7	115.2
7,500	119.3	111.4	124.1	114.6
8,000 (1.5 miles)	118.7	110.9	123.5	114.0
8,500	118.2	110.4	123.0	113.4
9,000	117.7	109.9	122.4	112.9
9,500	117.2	109.4	121.9	112.4
10,000 (1.9 miles)	116.7	108.9	121.5	111.9

Notes:
1. OASPL in dB (ref 20 micropascals). Thrust assumed to be 846,971 lbs for Falcon 9 and 2,540,913 for

the Falcon 9 Heavy.

is predicted to be 109.4 and 112.4 dBA, respectively (SpaceX 2010). Noise levels reaching Lompoc during a Titan IV launch were estimated to be between 100 and 104 dBA, and those reaching Santa Maria were estimated to be between 91 to 94 dBA. Based on OSHA and EPA criteria, noise levels were not expected to cause hearing damage, especially given the short duration of the sound (USAF 1988). Noise from a Falcon 9 or Falcon 9 Heavy launch would be anticipated to be less than that from a Titan IV launch based on the noise modeling and thrust factors.

Sonic boom modeling was also performed for the Falcon 9 vehicle (Appendix B). PCBoom3, a sonic boom modeling program, was use to predict the peak overpressures and impact locations of potential sonic booms on the NCI. Modeling incorporated four representative flight trajectories provided by SpaceX, and 30 daily meteorological conditions representing high wind, low wind, high temperature, low temperature, and median profiles for the months of January, March, July, September, and November. A total of 120 modeling runs were performed. Modeling specifically addressed the Falcon 9 vehicle and did not include modeling for the Falcon 9 Heavy vehicle. Modeling for the Falcon 9 Heavy vehicle would need to be completed prior to its first launch from VAFB.

Table 4-6 summarizes the modeling run results. Further details on specific trajectory results, as well as predicted impact location maps, are provided in Appendix B. Of the 120 total modeling runs, 119 runs resulted in predicted sonic booms impacting at least one of the three NCI. However, 88 of these runs were predicted to result in overpressures of less than 1 psf. Thirty-one of the modeling runs resulted in predicted sonic booms impacting the NCI with a peak overpressure ranging between 1 and 2.99 psf. Only one modeling run resulted in a predicted sonic boom impacting the islands with a peak overpressure that was greater than 3 psf.

SMI was the most frequently impacted island, followed by SRI and then SCI. Of the 120 total modeling runs, only three runs (2.5 percent) exceeded 2 psf (2.02, 2.17 and 2.31 psf). Only one modeling run (0.8 percent) exceeded the 3 psf level (3.4 psf). None of the 120 modeling runs exceeded the 6 psf level. Overpressures between 6 and 8 psf have a high potential to damage structures, including the potential to break glass and cause damage to plaster, walls, and roofs (SpaceX 2003). Table 4-7 shows peak overpressure levels as recorded during monitoring on SMI for past and current launch vehicle programs (MSRS 2008f). The Falcon 9 modeling falls within the range seen from previous and current launch programs at VAFB and is well below the 8.97 psf level that occurred under the Titan IV program.

Based on noise modeling and sonic boom modeling for the Falcon 9 vehicle, impacts from the Falcon 9 program are anticipated to be less than those from the Titan IV program and are anticipated to be less than significant.

Table 4-6. Summary of modeling run results for predicted impacts on the NCI from Falcon 9 launches.

Trajectory	Modeling Runs	Sonic booms impacting the NCI	< 1 psf			1 – 2.99 psf			> 3 psf		
			SMI	SRI	SCI	SMI	SRI	SCI	SMI	SRI	SCI
160°	30	30	30	30	29	--	--	--	--	--	--
175	30	30	28	29	18	2	1	--	--	--	--
177	30	30	28	21	7	2	9	2	--	--	--
190	30	29	9	9		19	2	--	1	--	--

Table 4-7. Peak overpressures as recorded on SMI for launches from VAFB.

Launch Vehicle	Date	Peak (psf)
Athena II Ikonos 1	27-Apr-99	0.95
Athena II Ikonos 2	24-Sep-99	0.96
Atlas IIAS MLV-10	8-Sep-01	0.75
Atlas IIAS MLV-14	2-Dec-03	0.88
Atlas V NROL-28	13-Mar-08	1.24
Delta II EO-1	21-Nov-00	0.40
Delta II Iridium 12	11-Feb-02	0.64
Delta II Aura	15-Jul-04	1.34
Delta IV NROL-22	27 Jun-06	0.77 or 3.36*
Titan IV B-12	22-May-99	1.84
Titan IV K-22	12-May-96	8.97

Note: * indicates an equipment malfunction resulted in uncertainty for this measurement.

4.5.2 Environmental Protection and Minimization Measures

Implementation of the environmental protection and minimization measures outlined below should avoid or minimize potential adverse effects to human health and safety during implementation of the Proposed Action. These measures are considered integral elements of the project description, and would be fully implemented.

- To provide for the health and safety of workers and visitors who may be exposed to hazards during modifications to SLC-4E and operation of the Falcon 9 and Falcon 9 Heavy launch programs, federal OSHA, and if applicable, California OSHA requirements would be implemented, and a Health and Safety Plan would be developed and implemented.

- To minimize the potential adverse impacts from biological (e.g., snakes and poison oak) and physical (e.g., rocky and slippery surfaces) hazards during construction, awareness training would be incorporated into the worker health and safety protocol.

- Coordination with the EOD Flight would occur prior to the start of any modifications made to SLC-4E.

4.5.3 No-Action Alternative

Under the No-Action Alternative, the modifications to SLC-4E would not occur, nor would the operation of the Falcon 9 and Falcon 9 Heavy launch programs from this facility. Therefore, there would be no impacts to human health and safety.

4.6 Orbital Debris

Since 1988, U.S. policy has been to minimize the creation of new orbital debris. The U.S. Government Orbital Debris Mitigation Standard Practices, as approved in 2001, contain the following four objectives:

1) To control debris released during normal operations

2) To minimize debris generated by accidental explosions

3) To select safe flight profiles and operational configurations, and

4) To provide for post-mission disposal of space structures

With these objectives, standard mitigation practices (U.S Government 1997) were developed and are summarized below.

To meet Objective 1, spacecraft and upper stages should be designed to eliminate or minimize debris released during normal operations. Planned release of debris larger than 5 millimeters in any dimension that remains on orbit for more than 25 years should be evaluated and justified on a basis of cost effectiveness and mission requirements.

To meet Objective 2, the design of spacecraft and upper stages should demonstrate via failure mode, effects analysis, or equivalent analysis, that there is no credible failure mode for accidental explosion or that design or operational procedures would limit the

probability of such occurrences. Secondly, all on-board sources of stored energy of a spacecraft or upper stage should be depleted or safed once no longer required, and as soon as possible without payload risk. Propellant depletion burns and compressed gas releases should be designed to minimize the probability of subsequent accidental collision and to minimize the impact of a subsequent accidental explosion.

Mitigation standard practices for Objective 3 include: 1) developing design and mission profiles for spacecraft and upper stages to estimate and limit the probability of collision with known objects during orbital lifetimes; 2) consistent with cost effectiveness, designing spacecraft to consider and limit the probability that collisions with debris smaller than 0.39-inch diameter would cause loss of control to prevent post-mission disposal; and 3) uniquely analyzing tether systems for both intact and severed conditions.

Finally, to meet Objective 4, a spacecraft or upper stage should be disposed of by one of three methods. The first method, atmospheric reentry, involves leaving the structure in orbit with a limited lifetime to no longer than 25 years after mission completion. If the structure would be disposed of by reentry into the Earth's atmosphere, the risk of human casualty would be less than 1 in 10,000. The second method would include maneuvering the structure to a storage orbit and away from an operational orbit regime. The third method would be direct retrieval, i.e. retrieving the structure and removing it from orbit as soon as practical after mission completion. For any method, tether systems should be uniquely analyzed for both intact and severed conditions when performing trade-offs between alternative disposal strategies.

4.6.1 Proposed Action

The analysis of impacts considered under the Proposed Action includes potential impacts from the Falcon 9 and Falcon 9 Heavy launch vehicles only. Orbital debris analysis for payloads launched on these vehicles would be conducted separately, as required under each payload's/satellite's program.

To comply with the U.S. policy to minimize the creation of new orbital debris, SpaceX would implement all U.S. Government or appropriate agency orbital debris mitigation standard practices for their spacecraft and upper stages that were relevant for the particular mission. The Falcon 9 and Falcon 9 Heavy vehicles are designed to not generate any debris during flight or during orbit operations. Because the Falcon 9 and Falcon 9 Heavy vehicles would utilize liquid propellants, the typical solid rocket motor aluminum oxide dust emission impacts to the space environment would not occur.

As applicable, structures that reach orbit would be programmed after spacecraft separation to burn residual propellants to depletion in a vector that would result in reentry in 2 to 3 months and result in a soft water landing. Upper stages going to higher orbits would not be subject to controlled reentry and would contribute to orbital debris. Their location would be tracked to permit avoidance with future launch trajectories. Up to 10 launches per year could contribute orbital debris to the environment. However, with the implementation of the U.S. Government Orbital Debris Mitigation Standard Practices as summarized above, or relevant agency (based on the particular mission) guidelines, the Falcon 9 and Falcon 9 Heavy programs are not anticipated to have a significant impact on the orbital debris environment.

4.6.2 No-Action Alternative

Under the No-Action Alternative, the Falcon 9 and Falcon 9 Heavy launch programs would not operate from SLC-4E. Therefore, there would be no increase in the quantity of orbital debris from the Falcon 9 and 9 Heavy programs.

4.7 Socioeconomics

Socioeconomic impacts would be considered significant if they substantially altered the location and distribution of the local population, caused the population to exceed historic growth rates, decreased jobs so as to substantially raise the regional unemployment rates or reduced income generation. They would also be considered significant if they substantially affected the local housing markets and vacancy rates, or resulted in the need for new social services and support facilities.

4.7.1 Proposed Action

4.7.1.1 Modification of SLC-4E

Modifications to SLC-4E, including the construction of the Hangar, would be anticipated to last approximately 24 months, once initial demolition of the existing mobile service tower was completed. Up to 100 local and 100 transient workers would be anticipated at SLC-4E during modification efforts. Local workers utilized on the project would come from those already employed personnel working in local or nearby areas. The transient workers are anticipated to be mainly comprised of current SpaceX employees from Florida, Texas, and other areas of California.

Modifications to SLC-4E would result in a temporary and minor increase in the number of personnel on VAFB. Because approximately half of the workers utilized during the modification of SLC-4E would come from the local area, and the remaining transient workers would only be in the area on a temporary basis, it is not anticipated that this workforce would alter the location or distribution of the local population, cause the population to exceed historic growth rates, or decrease jobs so as to substantially raise the regional unemployment rates or reduce income generation. Additionally, the local housing markets and vacancy rates would not be substantially affected, and no need for new social services and support facilities would be required. The modifications could result in a minor increase in employment during its duration, generating a small positive impact in the local area.

4.7.1.2 Falcon 9 and Falcon 9 Heavy Operations

When operations begin at SLC-4E, up to four launches of the Falcon 9 would be conducted per year. As the program matures, there could be a potential of 10 launches per year, including both Falcon 9 and Falcon 9 Heavy launches.

During a launch campaign (anticipated to last between 2 to 8 weeks), up to 100 local and 100 transient employees would be present at SLC-4E, including payload support personnel. Local and transient workers during launch campaigns would be comprised of similar personnel present during the modification effort, along with some workers associated with the payloads. Between launch campaigns, 30 to 50 employees would be present at the site, mainly consisting of local workers. As with the modification efforts, because approximately half of the workers for the Falcon 9 and Falcon 9 Heavy launch operations would come from the local area, and the remaining transient workers would only be in the area on a temporary basis, it is not anticipated that this workforce would alter the location or distribution of the local population, cause the population to exceed historic growth rates, or decrease jobs so as to substantially raise the regional unemployment rates or reduce income generation. Additionally, the local housing markets and vacancy rates would not be substantially affected and no need for new social services and support facilities would be required. Therefore, Falcon 9 and Falcon 9 Heavy program operations would not generate any negative socioeconomic impacts on the region.

4.7.2 No-Action Alternative

Under the No-Action Alternative, the modifications to SLC-4E would not occur, nor would the Falcon 9 and Falcon 9 Heavy

launch programs operate out of this facility. Therefore, there would be no impact to socioeconomic outlook for the affected area.

4.8 Solid Waste Management

Solid waste impacts are evaluated using federal, state, and local laws and regulations, permit conditions, and contract specifications. Adverse impacts would occur from non-compliance with applicable regulatory requirements or an increase in the amount of waste disposal that would exceed available waste management capacities.

4.8.1 Proposed Action

Pollution Prevention

The evaluation of potential P2 impacts from both modifications to SLC-4E and from Falcon 9 and Falcon 9 Heavy program operations includes consideration of solid waste diversion requirements. Construction and launch operations associated with the Proposed Action would create pollution in the air and water and would generate hazardous and solid waste. Non-compliance with applicable regulatory requirements or disposal of quantities of solid waste that would cause the proposed project not to meet mandated diversion rates would be considered an adverse impact. Debris from any activities would be segregated to facilitate subsequent P2 options. P2 options would be exercised in the following order: reuse of materials, recycling of materials, and then regulatory compliant disposal. With these options exercised, potential P2 impacts would be less than significant under the Proposed Action.

4.8.1.1 Modification of SLC-4E

C&D Debris

Solid waste generated during construction would include packaging from materials (cardboard and plastic), scrap rebar, wood, pipes, and wiring, asphalt and concrete from demolition of existing features, and miscellaneous waste generated by onsite construction workers. Contractors would be responsible for the disposal and/or recycling of all waste generated during the scope of the project. SpaceX would manage C&D materials to the maximum extent possible. Efforts to minimize capacity consumption of off-Base Santa Barbara County recyclers would be incorporated into all project planning.

All soil excavated during construction activities would be used as backfill, and any excess materials would be spread throughout the site. Asphalt and concrete would be recycled when possible, and disposed of at the CSML, or other approved facility if necessary.

Construction debris, along with green waste, used tires and other recyclable materials, would be segregated and diverted for reclamation. All green waste would be disposed of at an appropriate facility. The contractor would meet the applicable state or local diversion requirements in effect at the time of actual disposal.

Because demolition activities associated with the Proposed Action would be minimal and construction activities would be implemented over a 24-month period once the Mobile Service Tower was demolished, the addition of the solid wastes associated with the Proposed Action would result only in small increases in the amount of solid waste generated locally. The amount of solid waste generated is not anticipated to affect the daily maximum waste that the CSML or another approved facility could accept.

Compliance with all applicable federal, state, and local laws and regulations would govern all actions associated with implementing the Proposed Action and minimize the potential for adverse effects. Implementing the measures in Section 4.8.2, along with those detailed in the air and hazardous materials and waste management sections of this document, would ensure no significant adverse impacts for solid waste would occur.

4.8.1.2 Falcon 9 and Falcon 9 Heavy Operations

Operations conducted under the Falcon 9 and Falcon 9 Heavy programs are anticipated to generate less than 0.3 ton of solid waste per day. SpaceX would contract or perform in-house removal of solid waste to an off-Base recycling or disposal facility. The amount of solid waste generated would be anticipated to be minimal, and largely consist of administrative and personal material such as paper, cans, and bottles that would be recycled.

4.8.2 Environmental Protection and Minimization Measures

Implementation of the environmental protection and minimization measures outlined below should avoid or minimize potential adverse effects to solid waste management during implementation of the Proposed Action. These measures are considered integral elements of the project description, and would be fully implemented.

- Prior to structural demolition, salvageable, reusable, or recyclable materials, items and equipment would be removed to reduce the amount of solid waste disposal.
- Segregating and separately managing the different types of waste would reduce the amount of solid waste disposal.
- Segregating and processing the different types of debris into sizes, characteristics, and specifications identified by local recyclers as acceptable to their authorized processes would reduce solid waste disposal.

4.8.3 No-Action Alternative

Under the No-Action Alternative, the modifications to SLC-4E would not occur, nor would the operation of the Falcon 9 and Falcon 9 Heavy launch programs from this facility. Therefore, there would be no changes to solid waste levels or management under this alternative.

4.9 Transportation

Impacts to the transportation resources would be considered significant if:

- A primary roadway could no longer service the traffic demands of that roadway;
- The project access to a primary or local road would require access that would create an unsafe situation or a new traffic signal or major revisions to an existing traffic signal; or
- The project adds traffic to a roadway that has limiting design features or receives use that would be incompatible with substantial increases in traffic, which would become potential safety problems with the addition of project or cumulative traffic. Limiting design features include, but are not limited to narrow width, roadside ditches, sharp curves, poor sight distance, and inadequate pavement structure. Some examples of a roadway receiving incompatible use are large number of heavy trucks on rural roads used by farm equipment, livestock, horseback riding, or on residential roads with heavy pedestrian or recreational use.

4.9.1 Proposed Action

Given the good LOS currently experienced on the roadways that would be affected during SLC-4E modification and the Falcon 9 and Falcon 9 Heavy programs on VAFB, the slight increase in daily truck traffic anticipated under the Proposed Action would not result in adverse effects to their capacity. All VAFB roadway sections should continue to operate at an LOS in the range of A to C with project-added traffic. No new access would be required under project activities, and no unsafe roadways conditions are anticipated.

4.9.1.1 Modification of SLC-4E

During modifications to SLC-4E, increases to traffic would occur as a result of commuting by construction workers and the trucks transporting materials and equipment for activities associated with the modifications. Construction workers are anticipated to commute from within a 30-mile radius of the

Base (from Lompoc/Santa Maria areas). Parking for construction vehicles would be at a designated area within or adjacent to the proposed project area.

Truck trips on roads and highways in the vicinity of the proposed project area would be required to transport materials to the project site. These activities would be coordinated with California Department of Transportation (Caltrans) to ensure authorization of truck travel routes. A traffic control plan would be developed in coordination with the California Highway Patrol (CHP), and implemented to adequately facilitate the movement of traffic. The traffic control plan would cover all conditions to be encountered during construction.

Modifications to SLC-4E, including the construction of the Hangar, would be anticipated to last approximately 24 months and utilize up to 100 local and 100 transient workers during modification efforts. Previous modifications made to SLC-4E under the Titan IV program were estimated to utilize 474 personnel over an 8-month period and were found not to have significant impacts to transportation resources in the area (USAF 1988). Given that most roadways on VAFB operate at less than capacity, as do the major roadways in the surrounding area, and because the proposed project would utilize less workers than the Titan IV modifications, the additional workforce of up to 200 personnel at site during modifications for the Falcon 9 and Falcon 9 Heavy programs is also anticipated to have less than significant impacts on transportation resources.

4.9.1.2 Falcon 9 and Falcon 9 Heavy Launch Operations

During launch operations, ground transportation support would be minimal. It could consist of a truck to deliver the crane (if an external crane is required outside the Hangar or if the Hangar cranes are not yet complete) and four delivery trucks for delivery of the first stage, second stage, interstage, and payload. Shipment of these components would take place no more than 10 times per year. Additionally, it is estimated that 300 annual (or 6 weekly) truck trips would be required to deliver fuel, LOX, and helium to support the estimated 10 annual launch campaigns. It is not anticipated that this increase in truck traffic would not result in a significant impact to transportation resources.

During a launch campaign, up to 100 local and 100 transient employees would be present at SLC-4E for between 2 to 8 weeks. Between launch campaigns, 30 to 50 employees would be present at the site. Personal vehicles would be used by employees to commute locally on and off-site. During previous Titan IV launch operations up to 350 personnel were present at SLC-4E, while up to 175 personnel were present between launch campaigns during normal operations (USAF 1988). Therefore the numbers of employees present both during and between Falcon 9 and Falcon 9 Heavy program operations would not be an increase over previous levels and there would be no impact to transportation resources.

4.9.2 Environmental Protection and Minimization Measures

Implementation of the environmental protection and minimization measures outlined below should avoid or minimize potential adverse effects to transportation resources during implementation of the Proposed Action. These measures are considered integral elements of the project description, and would be fully implemented.

- Truck trips would be scheduled during non-peak traffic hours when possible.
- SpaceX would coordinate with Caltrans and the CHP for the transportation of materials to the project site, and for accessing the project site through Hwy 246.
- Warning signs, cones, and flaggers would be provided if necessary to warn roadway users of truck crossings on Hwy 246, and to control traffic flow if necessary.
- Construction equipment would not be parked along the shoulder of primary roadways during non-construction periods.

- Project employees would be encouraged to carpool and eat lunch on the site.

4.9.3 No-Action Alternative

Under the No-Action Alternative, no modifications to SLC-4E would occur, and the Falcon 9 and Falcon 9 Heavy launch programs would not operate from this facility. Therefore, there would be no effect on existing transportation resources.

4.10 Water Resources

Adverse impacts to water resources would occur if the Proposed Action: caused substantial flooding or erosion; adversely affected surface water quality to creeks, rivers, streams, lakes, or bays; or adversely affected surface or groundwater quality or quantity. An adverse effect to water resources would also be considered significant if it contributed to a shortage of water supply.

4.10.1 Proposed Action

4.10.1.1 Surface Water

Activities during modification of SLC-4E as well as during launch operations would include the use of hazardous materials and generation of wastewater that could result in an adverse impact to water resources if not properly controlled and managed. Proper management of materials and wastes during project activities would reduce or eliminate the potential for contaminated runoff. As required by the NPDES General Permits, BMPs would be implemented to properly manage materials, and reduce or eliminate project-associated runoff to further reduce the potential for adverse effects, especially during the rainy season.

Surface waters near SLC-4E could be affected by the exhaust cloud that would form near the launch pad at lift-off as a result of the exhaust plume and evaporation and subsequent condensation of deluge water. Because the Falcon 9 and Falcon 9 Heavy launch vehicles use only LOX and RP-1 propellants, the exhaust cloud would consist of steam only and would not contain any hazardous materials. As the volume of water expected to condense from the exhaust cloud is expected to be minimal, the exhaust cloud would generate less than significant impacts on surface water quality near SLC-4E.

Upon impact with the ocean, the first stage of the launch vehicle could expel residual RP-1 and LOX into the Pacific Ocean. Due to the small volume of this release into the open ocean, impacts on water quality would be less than significant.

General water quality objectives for inland surface waters for the Basin Plan or the California Ocean Plan are not expected to be exceeded due to the Falcon 9 or Falcon 9 Heavy program operations.

A CWA Section 401 Water Quality Certification from the Central Coast RWQCB and CWA Section 404 Permit from the U.S. Army Corps of Engineers (USACE) would not be required under the Proposed Action because no direct impacts to water bodies or wetlands would occur.

4.10.1.2 Groundwater

Groundwater is unlikely to be encountered during excavation activities, because the depth of excavation would not exceed 16 ft below ground surface during modifications at SLC-4E. The greatest threat to groundwater is contamination from hazardous materials or waste releases during modifications to SLC-4E and operational activities that could infiltrate an aquifer. This potential would be greatest during the rainy season. Proper management of hazardous materials and wastes during SLC-4E modifications and operational activities would reduce or eliminate the potential for contaminated infiltration.

Wastewater discharges that may occur during project activities, including accumulated stormwater and non-stormwater discharges, would be managed in accordance with the

VAFB *Discharge to Grade Program* and the General Industrial Permit. After a launch, approximately 9,000 gallons of deluge water per Falcon 9 launch and 24,000 gallons of deluge water per Falcon 9 Heavy launch would remain in the retention basin after evaporation. Samples of the deluge water would be collected and the results reported to VAFB under the Discharge to Grade Program. If the water is clean enough to go to grade, it would be discharged from the retention basin. It would then percolate into the groundwater system and flow down gradient into Spring Canyon Creek. With adherence to federal, state, and local laws and regulations, impacts to groundwater would be less than significant.

4.10.1.3 Stormwater

Modifications to SLC-4E

The Proposed Action would require coverage under the NPDES General Permit for Construction Activities (Construction General Permit) because the total disturbed area would be greater than 1 acre.

SpaceX would prepare and submit Permit Registration Documents (Notice of Intent [NOI], Notice of Termination [NOT], SWPPP, and Risk Assessment) to the 30 CES/CEANQ for review at least 1 month prior to the modification of SLC-4E. Permit Registration Documents would be certified by the Legally Responsible Person prior to electronic submittal to the SWRCB.

During modification activities, BMPs would be implemented to prevent contaminants from entering stormwater runoff. Exposed soils would be permanently stabilized to prevent erosion due to wind and rain. Once all permit termination requirements are met, a NOT would be submitted to the RWQCB by the Legally Responsible Person. With the implementation of these procedures and requirements, adverse effects to water resources from stormwater would be less than significant.

The existing hydrology at SLC-4E could be altered due to excavation and/or grading and the creation of impervious surfaces. The site has been previously disturbed and normal drainage patterns no longer exist. The design would include a hydrologic analysis using modeling or other recognized tools to establish the design objective for the water volume to be managed from the project site, and to demonstrate that the project meets the requirements of the Energy Independence and Security Act. The overall design objective for each project is to maintain pre-development hydrology and prevent any net increase in stormwater runoff. The DOD defines “pre-development hydrology” as the pre-project hydrologic conditions of temperature, rate, volume, and duration of stormwater flow from the project site. Project site design options shall be evaluated to achieve the design objective to the maximum extent technically feasible. Therefore, adverse impacts to natural drainages are not anticipated.

Falcon 9 and Falcon 9 Heavy Operations

Stormwater from the entire SLC-4E launch pad drains into the retention basin. Stormwater would be analyzed before any discharge takes place to determine if residues from the launch pad have contaminated stormwater and treatment is required.

Operational activities associated with the Proposed Action would require coverage under a NPDES General Industrial Permit prior to any discharge to grade of stormwater. The General Industrial Permit and related VAFB Storm Water Management Plan require BMPs to reduce and eliminate pollutants in stormwater and non-stormwater discharges associated with project activities. Compliance with BMPs should minimize potential adverse impacts to local water resources.

4.10.1.4 Wastewater Management

Wastewater generated during operation of the launch deluge water system for the Falcon 9 and Falcon 9 Heavy programs would be contained in the existing retention basin at SLC-4E. After a Falcon 9 vehicle launch, approximately 9,000 gallons of deluge water would remain in the retention basin after evaporation. After a Falcon 9 Heavy launch,

approximately 24,000 gallons would remain after evaporation. Because only LOX and RP-1 would be used as propellants, it is anticipated that the launch deluge wastewater would be characterized as non-hazardous. After launch, samples of the deluge water would be collected and analyzed and the results would be reported to VAFB and the RWQCB to determine if it meets the standards that would allow it to be discharged to grade. Water containing prohibited chemical levels would be removed and hauled to an approved industrial wastewater treatment facility outside of VAFB. With these measures in place, there would be less than significant impacts on water resources.

4.10.1.5 Domestic Wastewater Management

Domestic wastewater generated at SLC-4E would be managed via the existing septic sewer system during refurbishments and operation of the Falcon 9 and Falcon 9 Heavy programs. The existing septic system would be evaluated to determine if the system has sufficient capacity to support the number of personnel anticipated to be present during construction and operational activities. If it is determined to not have sufficient capacity, SpaceX would re-evaluate the management of domestic wastewater.

4.10.1.6 Water Supply

Under the Proposed Action, a maximum of 670,000 gallons (2.06 acre-ft) of potable water would be required per year for the Falcon 9 and Falcon 9 Heavy programs. This equates to approximately 0.1 percent of the 2009 VAFB monthly usage. The total increase in potable water use per year required for the Proposed Action is minimal, and would not noticeably affect the quantity of water available to VAFB or the surrounding area. Therefore, impacts on the water supply at VAFB would be less than significant.

Backflow prevention assemblies would be installed for water supply lines and fire suppression systems connected to the VAFB potable water distribution system to prevent cross-contamination and adverse impacts to the VAFB drinking water supply.

4.10.2 Environmental Protection and Minimization Measures

Implementation of the environmental protection and monitoring measures outlined below should avoid or minimize potential adverse effects to water resources during implementation of the Proposed Action.

- BMPs would be implemented per the SWPPPs required under the Construction General Permit and General Industrial Permit to prevent pollutants from entering into stormwater or groundwater. BMPS would include erosion and sediment controls, spill prevention and control, concrete waste management, solid waste management, and liquid waste management.
- Approval would be obtained from the 30 CES/CEANQ, Water Resources Manager, prior to any release to grade of any water (Discharge to Grade Program).
- Industrial wastewater (water containing prohibited chemical levels) would be taken to an approved industrial wastewater treatment facility outside of VAFB.
- After completion of refurbishment activities, areas with exposed disturbed soil would be stabilized per the NPDES Construction General Permit. Areas to be revegetated would be seeded during the rainy season. If seeding occurs during the dry season, hydromulch and/or irrigation would be supplied. The seed mix would be approved by 30 CES/CEA.
- If the septic system requires upgrade, SpaceX would coordinate with the 30 CES/CEANQ Water Resources section.
- To the extent allowed by funding, the project will be designed to maintain the pre-development hydrology and prevent any net increase in stormwater runoff to the maximum extent technically feasible.

4.10.3 No-Action Alternative

Under the No-Action Alternative, the modifications to SLC-4E would not occur, nor would the operation of the Falcon 9 and Falcon 9 Heavy launch programs from this facility. Therefore, there would be no effect on water resources under this alternative.

4.11 Cumulative Impacts

Adverse cumulative impacts (hereinafter referred to as "cumulative impacts") result from the incremental effect of an action when added to other past, present, and reasonably foreseeable future actions, regardless of the agency that undertakes these other actions. Cumulative impacts can result from actions whose adverse impacts are individually minor or negligible, yet over a period of time, are collectively significant.

Within the vicinity and region of influence of the Proposed Action, projects identified outside of VAFB include:

Public safety complex at Allan Hancock College (Lompoc) - The public safety complex project involves relocating the Public Safety program from its current facilities at the Allan Hancock College South Campus in the City of Santa Maria to Lompoc. Per environmental documents completed for this project, mitigation measures would be implemented to reduce adverse effects to biological resources, water resources, and air quality to less than significant.

Frick Springs Bridge Project (Lompoc) – The City of Lompoc is proposing to construct a 12-ft wide, 60-ft long prefabricated metal bridge over San Miguelito Creek, on the west side of San Miguelito Road, approximately 4 miles south of the City of Lompoc. Environmental documents for this project are under development. Resources that are of concern include biological resources, and hydrology and water quality. It is anticipated that any significant adverse effects would be mitigated to a less than significant level.

For projects occurring on VAFB, a partial list of projects for which NEPA analysis was completed within the past 5 years, including cumulative impacts analyses, is detailed in Table 4-8. Of these, projects that are currently in progress or will be implemented in the future at VAFB include: demolition and abandonment of Atlas and Titan facilities, upgrades to Western Range instrumentation, construction and operation of the California

Table 4-8. Partial list of projects for which NEPA analysis has been completed in the previous 5 years.

Name of Project	NEPA Analysis Timeframe	Project Timeframe
Demolition and Abandonment of Atlas and Titan Facilities	EA completed in 2005.	Project on-going.
Combat Information Transport System Upgrade	EA completed in 2006.	Project completed in 2007.
VTRS Supplement	EA completed in 2007.	Project completed in 2008.
New 13th Street Bridge	EA completed in 2007.	Project implementation in flux, currently no earlier than 2011.
San Antonio Creek Restoration	EA completed in 2008.	Project completed in 2010.
Western Range Instrumentation Upgrades	EA completed in 2008.	Project implementation started in 2008 with anticipated completion in 2011.
2007 General Plan for Main and South Base Cantonments	EA completed in 2008.	Projects to be implemented between 2009 and 2014.
Security Upgrade of Gates	EA completed in 2009.	Project implementation to be completed in 2012.
Construction and Operation of the California Space Center	EA completed in 2010.	Construction to be completed between 2011 and 2019.

Space Center, and several projects to occur within the main and South Base cantonments under the Military Construction and non-appropriated funds programs.

VAFB evaluates the cumulative impacts on the environment of all space launches based on a maximum of 30 launches per year. This rate is not exceeded and in most years the number of launches does not exceed 15. Launches of Falcon 9 and Falcon 9 Heavy would be included in the maximum 30 launches per year; thus, they would not represent an additional effect on resources beyond that already analyzed by the various launch programs.

Air quality impacts were considered in conjunction with on-going and future projects planned within and outside of VAFB. The cumulative emissions from the Proposed Action and past, present, and future projects on VAFB would not exceed the significance thresholds of 548 pounds/day or 100 tons/year. For those projects outside of VAFB that would have a substantial amount of emissions, mitigation would be implemented to reduce the levels to less than significant. Therefore, no significant cumulative impacts to the region's air quality would occur.

Adverse effects to biological resources under the Proposed Action should be minimized with the implementation of measures described in Sections 4.2.2 of this EA, identified in environmental documents completed for other projects, to be incorporated in environmental documents currently under development for future projects, and identified and established by VAFB for operations and maintenance (O&M) projects. With these measures in place, no significant cumulative impacts are anticipated.

The Proposed Action would have no effect on cultural resources. Therefore, no cumulative impacts would occur under this alternative.

No significant impacts to earth resources are anticipated from the Proposed Action, or any of the other projects considered in this analysis. Environmental documentation under development for future projects would identify any potential adverse effects to earth resources and describe measures to avoid or minimize these adverse effects. No cumulative impacts are anticipated.

When considered with other past, present, and future projects, the Proposed Action was found to have no cumulative impacts on environmental justice, as activities for the proposed project would occur within VAFB boundaries and not affect minority communities.

Hazardous materials/wastes encountered or generated by the Proposed Action would be managed in strict compliance with all applicable statutes and regulations to avert the potential for adverse impacts. Implementing the measures described in Section 4.5.2 of this EA, identified in the environmental documents completed for other projects, to be incorporated in environmental documents for future projects, including those identified and established by VAFB for O&M projects, should avoid or minimize any potential adverse effects. No significant cumulative impacts are anticipated.

Given the requirement to comply with federal and state OSHA regulations, and all other applicable federal, state, and local laws and regulations, no adverse impacts and therefore no cumulative impacts to human health and safety are anticipated for the Proposed Action.

No cumulative impacts are anticipated in regards to land use or aesthetics as the Proposed Action would not change land use, result in the conversion of prime agricultural land to other uses, or result in adverse effects.

With the implementation of the U.S. Government Orbital Debris Mitigation Standard Practices or NASA guidelines, the Proposed Action is not anticipated to have a significant cumulative impact on the orbital debris environment.

Given that half of the workers utilized during both modifications to SLC-4E and during Falcon 9 and Falcon 9 Heavy program

operations would be transient, already employed workers, and the 100 remaining workers represent only a small workforce to be utilized over a 24-month period, no adverse impacts to socioeconomics and therefore no cumulative impacts are expected under the Proposed Action.

Minimal levels of solid waste are anticipated to occur from modification made to SLC-4E under the Proposed Action. When possible, items would be recycled to the extent possible and any remaining solid waste would be properly disposed of at an appropriate landfill facility. With these measures in place no significant cumulative effects are anticipated from the Proposed Action.

Based on current LOS ratings, and with the implementation of measures described in Section 4.9.2 of this EA, identified in the environmental documents completed for other projects, and to be incorporated in environmental documents for future projects, as well as those identified and established by VAFB for O&M projects, activities covered under the Proposed Action would be unlikely to have significant impacts to the transportation system in the region. No cumulative impacts are anticipated.

All activities under the Proposed Action would be subject to all requirements contained in the NPDES Construction General Permit. Implementation of measures described in Section 4.10.2 of this EA, identified in environmental documents completed for other projects, to be incorporated in environmental documents for future projects, as well as identified and established by VAFB for O&M projects, should avoid or minimize any potential adverse effects. No significant cumulative impacts to water resources are anticipated.

To ensure that no significant cumulative impacts result from projects on VAFB that occur either concurrently or sequentially, VAFB includes environmental contract specifications and protective measures, when necessary, in all projects. Preventive measures are identified and defined by resource managers and actions are taken by project proponents and VAFB during the planning process to ensure adverse impacts are minimized, or avoided all together, as projects are reviewed under NEPA. Prior projects are also considered to ensure no levels of acceptable impacts are exceeded.

With these practices in place, and given that all projects on VAFB are designed and implemented to be in full compliance with applicable statutes and regulations, and environmental protection measures are developed in coordination with appropriate regulatory agencies, the activities included under the Proposed Action, in conjunction with other foreseeable projects at VAFB, would not result in significant cumulative impacts.

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Chapter 5. Persons and Agencies Contacted

Amena Atta, Restoration, 30 CES/CEANR, VAFB
LtCol Craig Bomberg, 30th Space Wing Safety, 30 SW/SE
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Chapter 7. Distribution List

Brownfield and Environmental Restoration Program, Department of Toxic Substances Control, Cypress, CA

California Coastal Commission, Federal Consistency Review, San Francisco, CA

California Native Plant Society, Los Osos, CA

Defense Technical Information Center

California Regional Water Quality Control Board, Central Coast Region, San Luis Obispo, CA

Environmental Defense Center, Santa Barbara, CA

La Purisima Audubon Society, Lompoc, CA

Lompoc Public Library, Lompoc, CA

Santa Barbara County Air Pollution Control District, Project Review, Santa Barbara, CA

Santa Barbara Museum of Natural History, Santa Barbara, CA

Santa Ynez Band of Chumash Indians, Tribal Elders Council, Santa Ynez, CA

Santa Barbara Public Library, Santa Barbara, CA

Santa Maria Public Library, Santa Maria, CA

University of California, Library, Santa Barbara, CA

U.S. Fish and Wildlife Service, Ventura Field Office, Ventura, CA

VAFB Library, VAFB, CA

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APPENDIX A:

Air Quality

Falcon 9 and Falcon 9 Heavy Launch Programs from SLC-4E, Vandenberg Air Force Base
Modification of SLC-4E
Construction Heavy Equipment - Emission Factors (lbs/hr)

Equipment	FUEL	HP	VOC	CO	NO_x	SO_x	PM_{10}	CO_2	CH_4	N_2O
Excavator CAT 330-B	DIESEL	268	0.62	0.20	1.93	0.00	0.07	233.74	0.02	0.18
Loader CAT 966 G	DIESEL	262	0.76	0.22	2.17	0.00	0.08	237.01	0.02	0.21
Water Truck	DIESEL	189	0.43	0.16	1.61	0.00	0.06	166.55	0.01	0.15
Dump Trucks	DIESEL	300	0.25	0.75	2.32	0.00	0.09	272.33	0.02	0.22
Motor Grader 670 Deere	DIESEL	15	0.14	0.36	0.30	0.00	0.03	27.54	0.01	0.03
Dozer 850 Deere	DIESEL	170	0.19	0.76	1.48	0.00	0.09	121.19	0.02	0.14
Compactor 8 Ton Vibratory	DIESEL	100	0.12	0.42	0.74	0.00	0.06	58.99	0.01	0.07
Forklift - All Terrain Telehandler	DIESEL	85	0.12	0.44	0.73	0.00	0.07	62.45	0.01	0.07
Crane - 75 Ton	DIESEL	200	0.12	0.35	1.24	0.00	0.05	112.16	0.01	0.12
Scraper CAT 623F	DIESEL	330	0.37	1.52	3.42	0.00	0.14	321.43	0.03	0.33
Skid Loader with Drag John Deere 210C	DIESEL	65	0.06	0.28	0.41	0.00	0.04	42.76	0.01	0.04
Backhoe Loader 410 Deere	DIESEL	85	0.09	0.36	0.57	0.00	0.05	51.73	0.01	0.05

Falcon 9 and Falcon 9 Heavy Launch Programs from SLC-4E, Vandenberg Air Force Base
Modification of SLC-4E
Construction Heavy Equipment - Total Emissions (tons)

Equipment	No of Equip.	Hrs of Use	VOC	CO	NO_x	SO_x	PM_{10}	$PM_{2.5}$	CO_2	CH_4	N_2O
Excavator CAT 330-B	1	220	0.07	0.02	0.21	0.00	0.01	0.01	25.71	0.00	0.02
Loader CAT 966 G	1	80	0.03	0.01	0.09	0.00	0.00	0.00	9.48	0.00	0.01
Water Truck	1	80	0.02	0.01	0.06	0.00	0.00	0.00	6.66	0.00	0.01
Dump Trucks	4	120	0.06	0.18	0.56	0.00	0.02	0.02	65.36	0.01	0.05
Motor Grader 670 Deere	1	100	0.01	0.02	0.01	0.00	0.00	0.00	1.38	0.00	0.00
Dozer 850 Deere	1	100	0.01	0.04	0.07	0.00	0.00	0.00	6.06	0.00	0.01
Compactor 8 Ton Vibratory	1	40	0.00	0.01	0.01	0.00	0.00	0.00	1.18	0.00	0.00
Forklift - All Terrain Telehandler	1	100	0.01	0.02	0.04	0.00	0.00	0.00	3.12	0.00	0.00
Crane - 75 Ton	1	10	0.00	0.00	0.01	0.00	0.00	0.00	0.56	0.00	0.00
Scraper CAT 623F	1	100	0.02	0.08	0.17	0.00	0.01	0.01	16.07	0.00	0.02
Skid Loader with Drag John Deere 210C	1	100	0.00	0.01	0.02	0.00	0.00	0.00	2.14	0.00	0.00
Backhoe Loader 410 Deere	1	60	0.00	0.01	0.02	0.00	0.00	0.00	1.55	0.00	0.00
Total - Short tons			***0.23***	***0.41***	***1.28***	***0.00***	***0.06***	***0.05***	***139.27***	***0.01***	***0.12***
Total - Metric tons			***0.20***	***0.37***	***1.16***	***0.00***	***0.05***	***0.04***	***126.35***	***0.01***	***0.11***

Falcon 9 and Falcon 9 Heavy Launch Programs from SLC-4E, Vandenberg Air Force Base
Modification of SLC-4E
Construction Truck Trips - Emission Factors

Vehicle Class	Truck Trips	Speed (mph)	VMT (mi/veh-day)	CO Running Exhaust (g/mi)	NO_x Running Exhaust (g/mi)	VOCs Running Exhaust (g/mi)	SO_x Running Exhaust (g/mi)	PM_{10}			CO_2 Running Exhaust (g/mi)	CH_4 Running Exhaust (g/mi)	N_2O Running Exhaust (g/mi)
								Running Exhaust (g/mi)	Tire Wear (g/mi)	Brake Wear (g/mi)			
Heavy-Duty Truck	5	15	80	4.14	14.45	0.81	0.02	0.47	0.04	0.03	1,827.81	0.04	1.37

Falcon 9 and Falcon 9 Heavy Launch Programs from SLC-4E, Vandenberg Air Force Base
Modification of SLC-4E
Construction Truck Trips - Emissions

Vehicle Class	Truck Trips	Speed (mph)	VMT (mi/veh-	Days	Emissions (lbs/day)								
					CO	NO_x	VOCs	SO_x	PM_{10}	$PM_{2.5}$	CO_2	CH_4	N_2O
Heavy-Duty Truck	5	15	80	250	3.65	12.74	0.71	0.01	0.47	0.46	1,611.86	0.03	1.21

Vehicle Class	Truck Trips	Speed (mph)	VMT (mi/veh-	Days	Emissions (short tons/year)								
					CO	NO_x	VOCs	SO_x	PM_{10}	$PM_{2.5}$	CO_2	CH_4	N_2O
Heavy-Duty Truck	5	15	80	250	0.46	1.59	0.09	0.00	0.06	0.06	201.48	0.00	0.15
					Emissions (metric tons/year)								
					0.41	1.44	0.08	0.00	0.05	0.05	182.78	0.00	0.14

NOTES:
Assuming 40 miles round trip per vehicle
Assume startup after 8 hours
Assume 45 minutes run time total
Emission Factors from EMFAC2007, average temp 60F

Falcon 9 and Falcon 9 Heavy Launch Programs from SLC-4E, Vandenberg Air Force Base
Modification of SLC-4E
Worker Trips - Emission Factors

Vehicle Class	No. Workers	Speed (mph)	VMT (mi/veh-day)	CO		NO_X		VOCs					
				Running Exhaust (g/mi)	Start-Up (g/start)	Running Exhaust (g/mi)	Start-Up (g/start)	Running Exhaust (g/mi)	Start-Up (g/start)	Hot-Soak (g/trip)	Resting Loss (g/hr)	Running Evap (g/mi)	Diurnal Evap (g/hr)
Light-duty truck, catalyst	200	35	40	5.49	17.19	0.63	0.82	0.15	1.37	0.34	0.04	0.09	0.10

Vehicle Class	No. Workers	Speed (mph)	VMT (mi/veh-day)	SOx		PM_{10}				CO_2		CH_4	
				Running Exhaust (g/mi)	Start-Up (g/start)	Running Exhaust (g/mi)	Start-Up (g/start)	Tire Wear (g/mi)	Brake Wear (g/mi)	Running Exhaust (g/mi)	Start-Up (g/start)	Running Exhaust (g/mi)	Start-Up (g/start)
Light-duty truck, catalyst	200	35	40	0.00	0.00	0.01	0.02	0.01	0.01	384.76	205.72	0.04	0.08

Vehicle Class	No. Workers	Speed (mph)	VMT (mi/veh-day)	N_2O	
				Running Exhaust (g/mi)	Start-Up (g/start)
Light-duty truck, catalyst	200	35	40	0.06	0.08

Falcon 9 and Falcon 9 Heavy Launch Programs from SLC-4E, Vandenberg Air Force Base
Modification of SLC-4E
Worker Trips - Emissions

Vehicle Class	No. Workers	Speed (mph)	VMT (mi/veh	lbs/day								
				CO	NOx	VOCs	SOx	PM_{10}	$PM_{2.5}$	CO_2	CH_4	N_2O
Light-duty truck, catalyst	200	35	40	111.90	11.76	6.31	0.07	0.61	0.61	6,967.53	0.84	1.12

Vehicle Class	No. Workers	Speed (mph)	VMT (mi/veh	Days	short tons/year								
					CO	NOx	VOCs	SOx	PM_{10}	$PM_{2.5}$	CO_2	CH_4	N_2O
Light-duty truck, catalyst	200	35	40	250	13.99	1.47	0.79	0.01	0.08	0.08	870.94	0.11	0.14
					metric tons/year								
					12.69	1.33	0.72	0.01	0.07	0.07	790.10	0.10	0.13

NOTES:
Assuming 40 miles round trip per vehicle
Assume startup after 8 hours
Assume 45 minutes run time total
Emission Factors from EMFAC2007, average temp 60F

Falcon 9 and Falcon 9 Heavy Launch Programs from SLC-4E, Vandenberg Air Force Base
Modification of SLC-4E
Fugitive Dust Emissions

Phase	Total Acres	Emission Factor (lbs/acre-day)	Emissions (tons PM_{10})	Emissions (tons $PM_{2.5}$)
Grading	1	20	0.02	0.0042

Emission Factors: SCAQMD CEQA Air Quality Handbook, Appendix A; URBEMIS Model, Grading Emission factor (default)

Falcon 9 and Falcon 9 Heavy Launch Programs from SLC-4E, Vandenberg Air Force Base
Modification of SLC-4E
Architectural Coatings (Commercial Development)

Square Feet Coated Surface Area	Emission Factor for ROC (lbs/1,000 ft^2)	Total Emissions (tons)
60,000	4.62	0.14

NOTES:
Calculation Methodology - Table A11-13-D, SCAQMD CEQA Handbook

Assumptions:
30,000 square feet building size
2.0 square feet of surface area to be coated per square foot of floor space

Falcon 9 and Falcon 9 Heavy Launch Programs from SLC-4E, Vandenberg Air Force Base
Operations
Launch Workers - Emission Factors

Vehicle Class	No. Workers	Speed (mph)	VMT (mi/veh-day)	CO		NO_X		VOCs					
				Running Exhaust (g/mi)	Start-Up (g/start)	Running Exhaust (g/mi)	Start-Up (g/start)	Running Exhaust (g/mi)	Start-Up (g/start)	Hot-Soak (g/trip)	Resting Loss (g/hr)	Running Evap (g/mi)	Diurnal Evap (g/hr)
Light-duty truck, catalyst	200	35	40	5.49	17.19	0.63	0.82	0.15	1.37	0.34	0.04	0.09	0.10

Vehicle Class	No. Workers	Speed (mph)	VMT (mi/veh-day)	SOx		PM_{10}				CO_2		CH_4	
				Running Exhaust (g/mi)	Start-Up (g/start)	Running Exhaust (g/mi)	Start-Up (g/start)	Tire Wear (g/mi)	Brake Wear (g/mi)	Running Exhaust (g/mi)	Start-Up (g/start)	Running Exhaust (g/mi)	Start-Up (g/start)
Light-duty truck, catalyst	200	35	40	0.00	0.00	0.01	0.02	0.01	0.01	384.76	205.72	0.04	0.08

Vehicle Class	No. Workers	Speed (mph)	VMT (mi/veh-day)	N_2O	
				Running Exhaust (g/mi)	Start-Up (g/start)
Light-duty truck, catalyst	200	35	40	0.06	0.08

Falcon 9 and Falcon 9 Heavy Launch Programs from SLC-4E, Vandenberg Air Force Base
Operations
Launch Workers - Emissions

Vehicle Class	No. Workers	Speed (mph)	VMT (mi/veh	lbs/day								
				CO	NOx	VOCs	SOx	PM_{10}	$PM_{2.5}$	CO_2	CH_4	N_2O
Light-duty truck, catalyst	200	35	40	111.90	11.76	6.31	0.07	0.61	0.61	6,967.53	0.84	1.12

Vehicle Class	No. Workers	Speed (mph)	VMT (mi/veh	Days	Tons/year								
					CO	NOx	VOCs	SOx	PM_{10}	$PM_{2.5}$	CO_2	CH_4	N_2O
Light-duty truck, catalyst	200	35	40	250	13.99	1.47	0.79	0.01	0.08	0.08	870.94	0.11	0.14

NOTES:
Assuming 40 miles round trip per vehicle
Assume startup after 8 hours
Assume 45 minutes run time total
Emission Factors from EMFAC2007, average temp 60F

Falcon 9 and Falcon 9 Heavy Launch Programs from SLC-4E, Vandenberg Air Force Base Operations
Emergency Generators Emission Factors

	Number	Kilowatts	Horsepower	Emission Factors (lbs/hp-hr)					
				CO	ROC	NOx	SOx	PM_{10}	CO_2
Emergency Generator	2	160	214.56	0.00668	0.00251	0.03100	0.00205	0.00220	1.15000

Falcon 9 and Falcon 9 Heavy Launch Programs from SLC-4E, Vandenberg Air Force Base Operations
Emergency Generators Emissions

	Number	Kilowatts	Horsepower	Emissions (lbs/hour)					
				CO	ROC	NOx	SOx	PM_{10}	CO_2
Emergency Generator	2	160	214.56	2.87	1.08	13.30	0.88	0.94	493.49

	Number	Kilowatts	Horsepower	Emissions short tons/year)					
				CO	ROC	NOx	SOx	PM_{10}	CO_2
				0.48	0.18	2.23	0.15	0.16	82.91
Emergency Generator	2	160	214.56	Emissions (metric tons/year)					
				0.44	0.16	2.03	0.13	0.14	75.21

Falcon 9 and Falcon 9 Heavy Launch Programs from SLC-4E, Vandenberg Air Force Base
Operations at SLC-4E
Heavy-Duty Truck Trips - Emission Factors

Vehicle Class	Daily Truck Trips	Speed (mph)	VMT (mi/veh-day)	CO Running Exhaust (g/mi)	NO_x Running Exhaust (g/mi)	VOCs Running Exhaust (g/mi)	SO_x Running Exhaust (g/mi)	PM_{10}			CO_2 Running Exhaust (g/mi)	CH_4 Running Exhaust (g/mi)	N_2O Running Exhaust (g/mi)
								Running Exhaust (g/mi)	Tire Wear (g/mi)	Brake Wear (g/mi)			
Heavy-Duty Truck	1.2	40	100	4.14	14.45	0.81	0.02	0.47	0.04	0.03	1,827.81	0.04	1.37

Falcon 9 and Falcon 9 Heavy Launch Programs from SLC-4E, Vandenberg Air Force Base
Operations at SLC-4E
Heavy-Duty Truck Trips - Emissions

Vehicle Class	Daily Truck Trips	Speed (mph)	VMT (mi/veh-day)	Days	Emissions (lbs/day)								
					CO	NO_x	VOCs	SO_x	PM_{10}	$PM_{2.5}$	CO_2	CH_4	N_2O
Heavy-Duty Truck	1.2	40	100	250	1.09	3.82	0.21	0.00	0.14	0.14	483.56	0.01	0.36

Vehicle Class	Daily Truck Trips	Speed (mph)	VMT (mi/veh-day)	Days	Emissions (short tons/year)								
					CO	NO_x	VOCs	SO_x	PM_{10}	$PM_{2.5}$	CO_2	CH_4	N_2O
Heavy-Duty Truck	1.2	40	100	250	0.14	0.48	0.03	0.00	0.02	0.02	60.44	0.00	0.05
					Emissions (metric tons/year)								
					0.12	0.43	0.02	0.00	0.02	0.02	54.83	0.00	0.04

NOTES:
Assumes a total of 300 truck trips per year to support 10 launch campaigns annually
Assumes 100 miles round trip per vehicle
Assume startup after 8 hours
Assume 120 minutes run time total
Emission Factors from EMFAC2007, average temp 60F

Falcon 9 and Falcon 9 Heavy Launch Programs from SLC-4E, Vandenberg Air Force Base Operations
Launch Greenhouse Emissions - Emission Factors (kg/gallon)

Launch Vehicle	Fuel Use (gallons/launch)	CO_2	CH_4	N_2O
Falcon 9	35,000	9.76	0.0015	0.0001
Falcon 9 Heavy	100,000	9.76	0.0015	0.0001

Falcon 9 and Falcon 9 Heavy Launch Programs from SLC-4E, Vandenberg Air Force Base Operations
Launch Greenhouse Emissions - Emissions (metric tons/launch)

Launch Vehicle	Fuel Use (gallons/launch)	CO_2	CH_4	N_2O
Falcon 9	35,000	341.60	0.0525	0.0035
Falcon 9 Heavy	100,000	976.00	0.1500	0.0100
Total 10 launches (5 of each)		***6,588.00***	***1.0125***	***0.0675***

Emission factors for kerosene, from California Climate Action Registry General Reporting Protocol, Version 3.1, January 2009.

APPENDIX B:

Sonic Boom Modeling

SONIC BOOM MODELING FOR FALCON 9 SPACE VEHICLE FROM SPACE LAUNCH COMPLEX 4 EAST ON VANDENBERG AIR FORCE BASE, CALIFORNIA

Introduction

Space Exploration Technologies (SpaceX) proposes to launch its Falcon 9 space launch vehicle from Space Launch Complex (SLC)-4E on Vandenberg Air Force Base (VAFB), California. In order to understand potential sonic boom impacts from these launches on the northern Channel Islands (NCI), ManTech SRS Technologies, Inc. used PCBoom3, a sonic boom modeling program, to predict the peak overpressures and impact locations of potential sonic booms on the NCI.

Three islands make up the main NCI and include San Miguel Island (SMI), Santa Rosa Island (SRI), and Santa Cruz Island (SCI). SMI is the westernmost island and it is approximately 65 kilometers (km) southeast of SLC-4E. The eastern side of SCI, the easternmost island, is approximately 120 km southeast of SLC-4E.

Methods

ManTech SRS Technologies, Inc. used PCBoom3 to predict the peak overpressures and impact locations of potential sonic booms on the NCI, as generated by Falcon 9 vehicles during launches. The modeling program incorporated information for four representative flight trajectories (160, 175, 177 and 190 degree azimuths) provided by SpaceX, and 30 daily meteorological conditions. The 30 meteorological conditions were selected from a 10-year RAWINSONDE database and represented high wind, low wind, low temperature, high temperature, and median profiles for each of 6 months (January, March, May, July, September, November). A total of 120 modeling runs (30 daily meteorological conditions per trajectory) were performed.

This modeling specifically addressed the Falcon 9 launch vehicle, and did not include the Falcon 9 Heavy vehicle, as trajectory information for that vehicle was not

available. Additional modeling will need to be accomplished for that vehicle prior to its first launch from SLC-4E.

Results

Of the 120 total modeling runs, 119 runs resulted in predicted sonic booms impacting at least one of the three NCI. However, 88 of these runs were predicted to result in overpressures of less than 1 pound per square foot (psf). Thirty-one of the modeling runs resulted in predicted sonic booms impacting the NCI with a peak overpressure ranging between 1 and 2.99 psf. Only one modeling run resulted in a predicted sonic boom impacting the islands with a peak overpressure that was greater than 3 psf. Table B-1 summarizes the modeling run results. Further details on the specific trajectories are provided below.

Table B-1. Summary of modeling run results for predicted impacts on the NCI from Falcon 9 launches.

Trajectory	Modeling Runs	Sonic booms impacting the NCI	< 1 psf			1 – 2.99 psf			> 3 psf		
			SMI	SRI	SCI	SMI	SRI	SCI	SMI	SRI	SCI
160°	30	30	30	30	29	--	--	--	--	--	--
175	30	30	28	29	18	2	1	--	--	--	--
177	30	30	28	21	7	2	9	2	--	--	--
190	30	29	9	9		19	2	--	1	--	--

160 Degree Trajectory

All 30 modeling runs with the 160 degree trajectory produced sonic booms predicted to impact SMI and SRI. Twenty-nine of the 30 runs had booms predicted to impact SCI. None of the modeling runs resulted in predicted sonic booms impacting any of the NCI with a peak overpressure that was greater than 1 psf. The closest boom with a peak overpressure above 1 psf was approximately 1 km offshore of SMI. Figure B-1 depicts the modeling results for the 160 degree trajectory path.

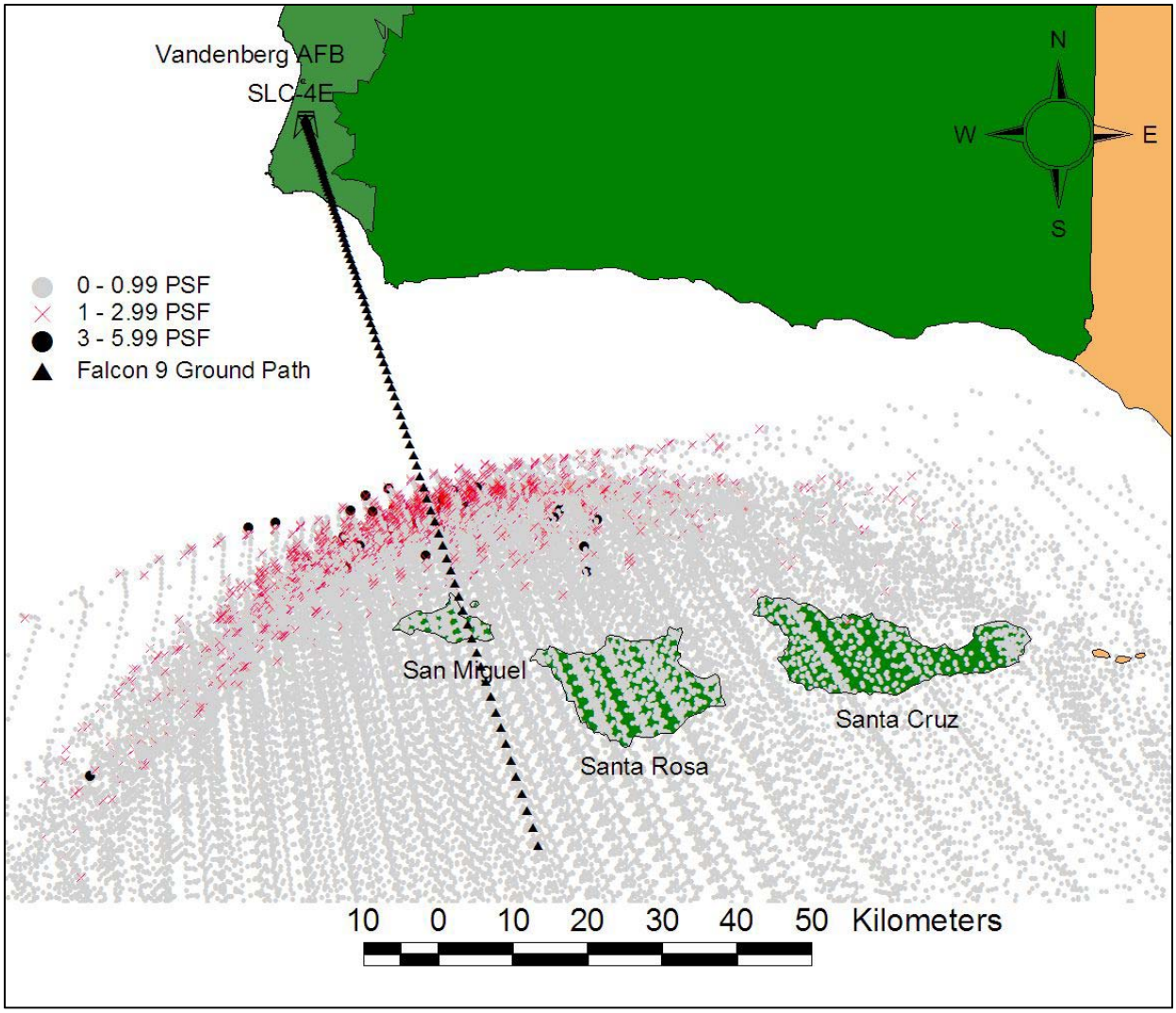

Figure B-1. Modeling results from the 160 degree trajectory path for Falcon 9 launches from SLC-4E.

175 Degree Trajectory

The 175 degree trajectory resulted in all 30 of the modeling runs producing sonic booms predicted to impact SMI and SRI, and 18 of the 30 runs with booms predicted to impact SCI. Twenty-seven of the 30 runs did not result in booms greater than 1 psf impacting any of the three NCI. Two modeling runs resulted in predicted booms with peak overpressures of 1.56 and 1.8 psf that impacted SMI, and one run resulted in a predicted boom of 1.45 psf that impacted SRI. Figure B-2 depicts the modeling results for the 175 degree trajectory path.

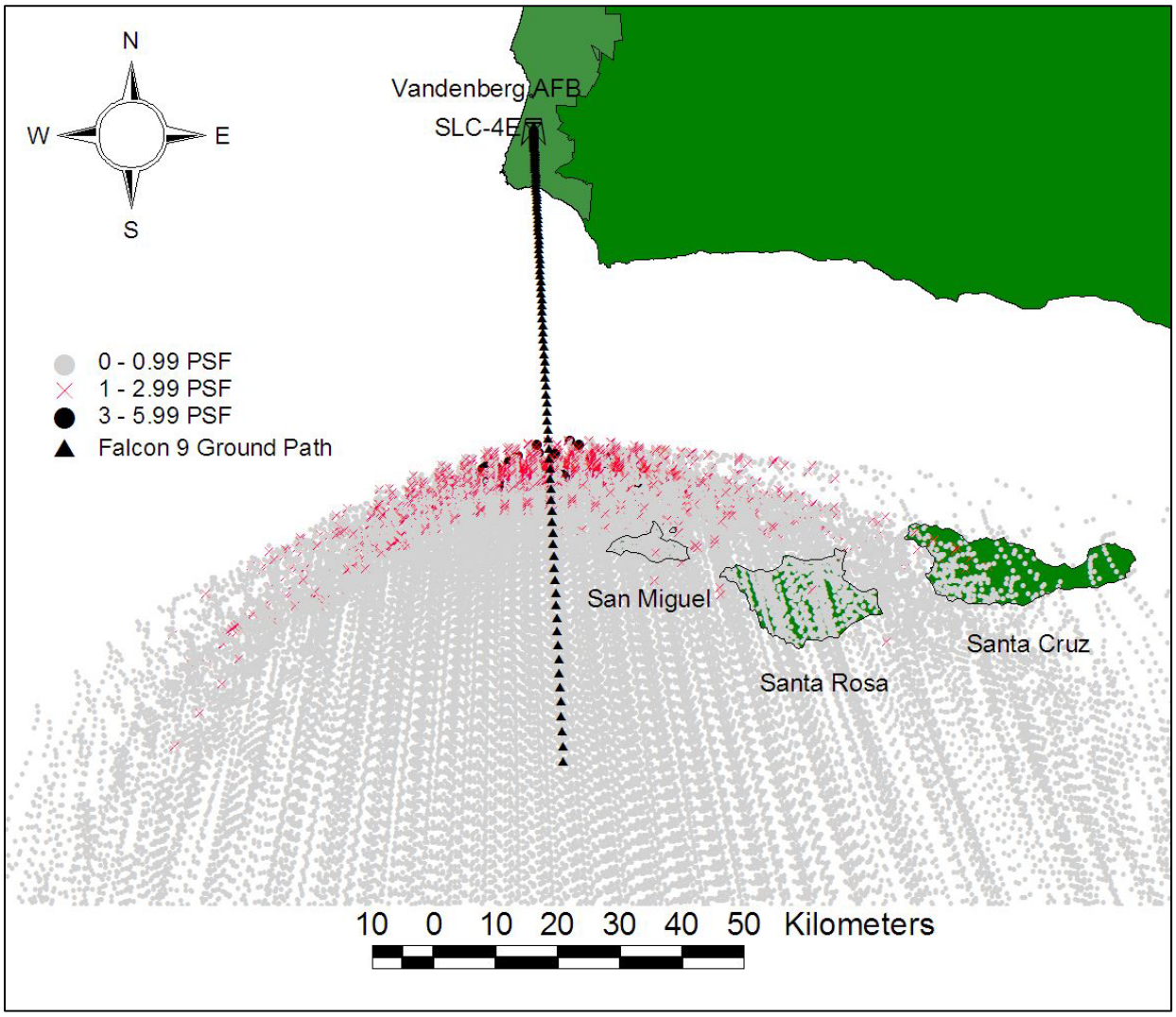

Figure B-2. Modeling results from the 175 degree trajectory path for Falcon 9 launches from SLC-4E.

177 Degree Trajectory

The 177 degree trajectory resulted in all 30 of the modeling runs producing sonic booms predicted to impact SMI and SRI, and nine of the runs with booms predicted to impact SCI. Twenty of the 30 runs did not result in booms greater than 1 psf impacting any of the three NCI. Two modeling runs resulted in predicted booms with peak overpressures of 1.28 and 1.34 psf that impacted SMI, nine runs resulted in predicted booms with peak overpressures between 1 and 1.56 psf that impacted SRI, and two run

resulted in predicted booms with peak overpressures of 1.5 psf that impacted SCI. Figure B-3 depicts the modeling results for the 177 degree trajectory path.

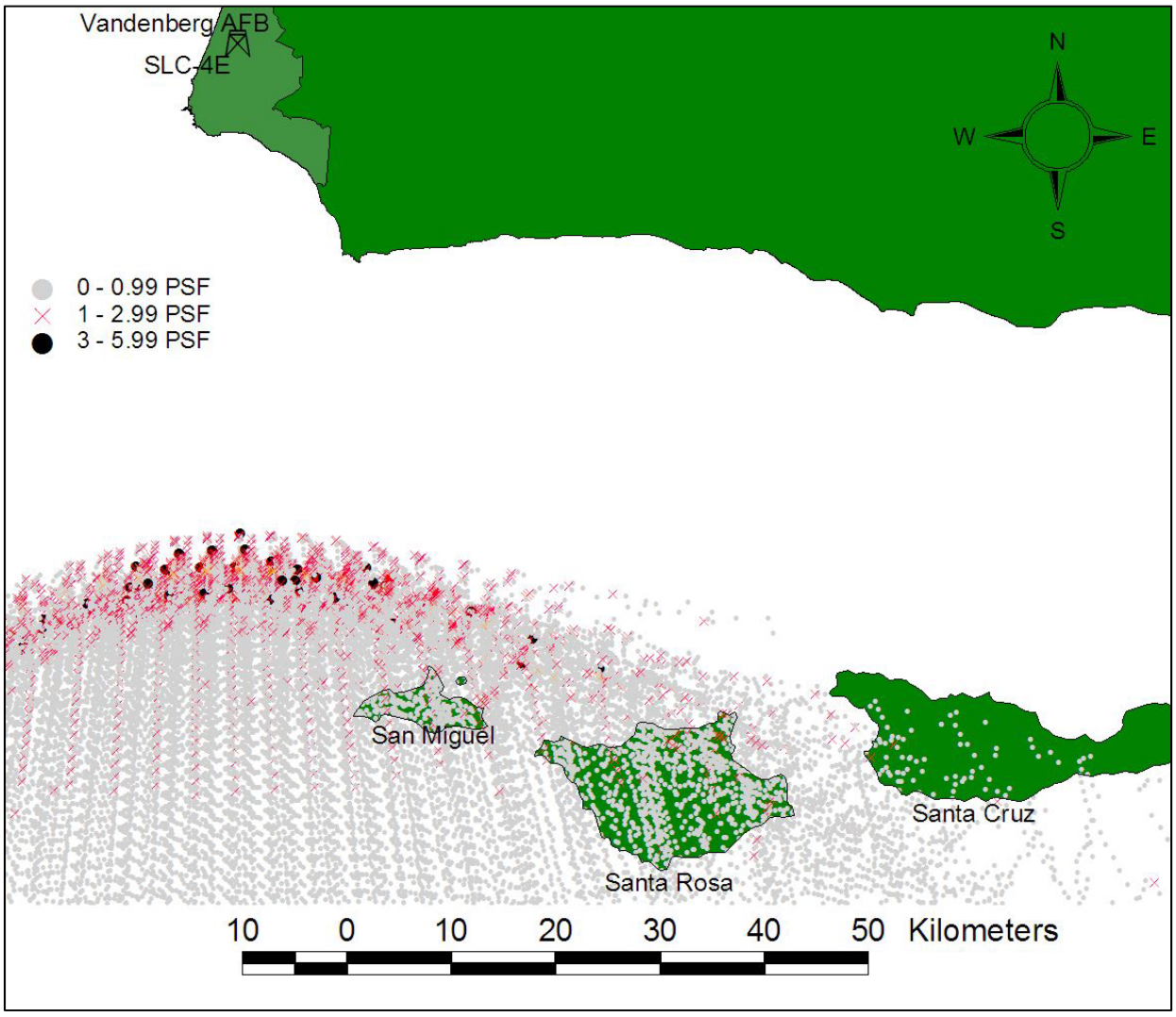

Figure B-3. Modeling results from the 177 degree trajectory path for Falcon 9 launches from SLC-4E.

190 Degree Trajectory

The 190 degree trajectory resulted in 29 of the 30 modeling runs producing sonic booms predicted to impact the NCI, although 10 of these runs did not result in booms predicted to be greater than 1 psf. All 29 runs resulted in booms predicted to impact SMI. Nineteen of the 29 runs were predicted to result in booms with peak

overpressures between 1 and 2.99 psf. Of these 19 runs, three were predicted to exceed 2 psf (2.02, 2.17 and 2.31 psf). One modeling run had a peak overpressure predicted to be above 3 psf (3.4 psf). Eleven of the modeling runs resulted in predicted sonic booms that impacted SRI. Only 2 of those 11 runs resulted in predicted booms with peak overpressures that were greater than 1 psf, with the greatest overpressure being 1.74 psf. No modeling runs produced sonic booms that were predicted to impact SCI. Figure B-4 depicts the modeling results for the 190 degree trajectory path.

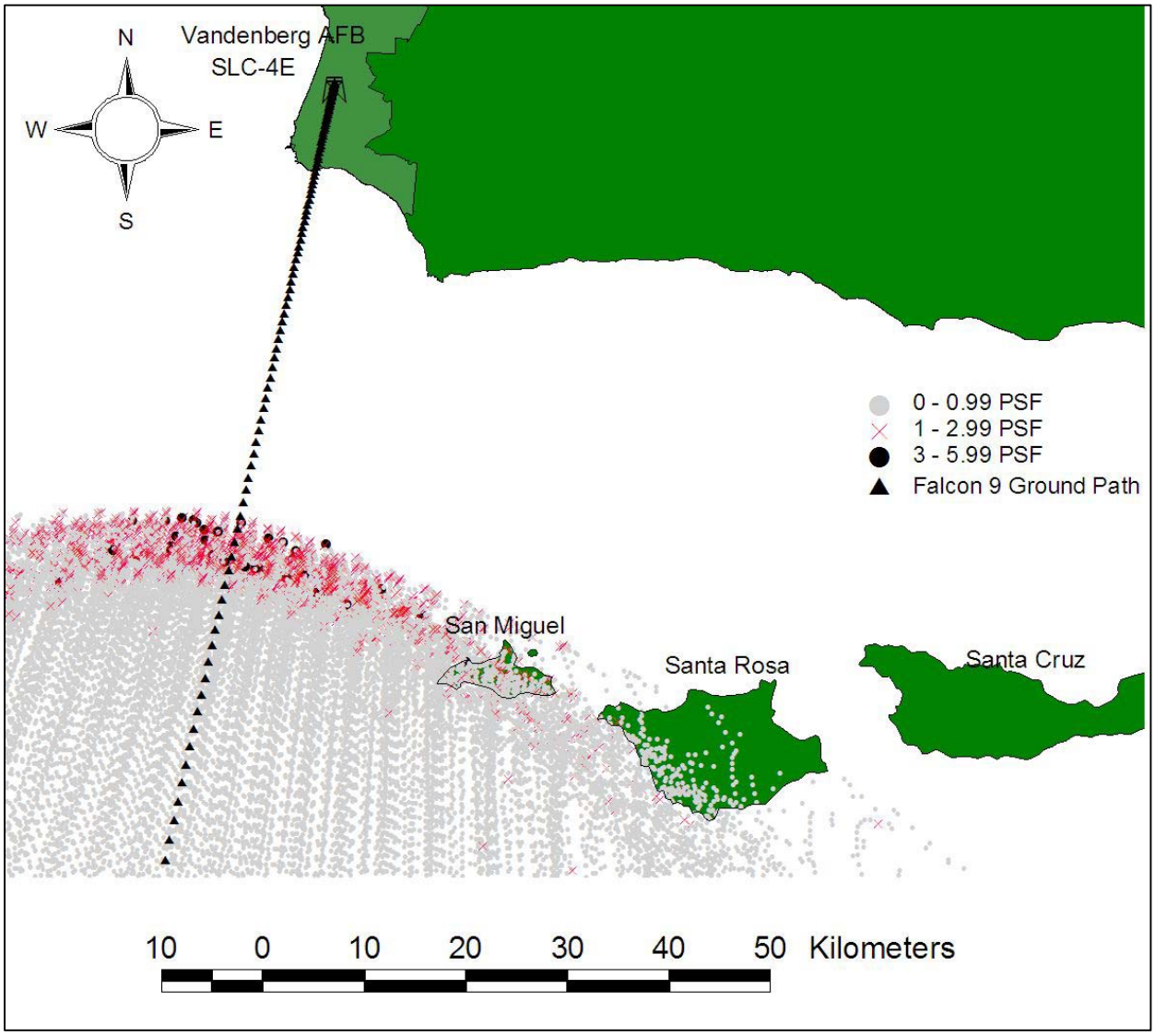

Figure B-4. Modeling results from the 190 degree trajectory path for Falcon 9 launches from SLC-4E.

SUMMARY

Based on the four representative trajectories provided by SpaceX, 99 percent (119 of 120 runs) of the modeling runs resulted in predicted sonic booms impacting the NCI, although 73 percent (88 of 120 runs) predicted sonic booms with peak overpressures that were less than 1 psf (Table B-2). SMI was the most frequently impacted island, followed by SRI and then SCI. Twenty-six percent (31 of 120 runs) of the modeling runs resulted in predicted sonic booms with peak overpressures ranging between 1 and 2.99 psf, with the majority of these ranging between 1 and 2 psf. Of the 120 total modeling runs, only three runs (2.5 percent) exceeded 2 psf (2.02, 2.17 and 2.31 psf). Only one modeling run (0.8 percent) exceeded the 3 psf level (3.4 psf). All of the runs that exceeded 2 psf level occurred under the 190 degree trajectory path. None of the 120 modeling runs exceeded the 6 psf level.

Table B-2. Peak overpressure ranges (by percentage) resulting from four representative trajectories for the Falcon 9.

Trajectory	Footprints impacting NCI	Less than 1 psf	1-2.99 psf	3-5.99 psf	>6 psf
160°	100%	100%	0%	0%	0%
175°	100%	90%	10%	0%	0%
177°	100%	67%	33%	0%	0%
190°	97%	31%	63%	3%	0%
Total %	99%	73%	26%	0.8%	0%

APPENDIX C:

Public Review Comments

RESPONSES TO PUBLIC COMMENTS

During the public review period, the following agencies provided comments for the Environmental Assessment (EA) and Finding of No Significant Impact (FONSI):

- Santa Barbara County Air Pollution Control District

- California Regional Water Quality Control Board – Central Coast Region

- United Launch Alliance

Comments received are included in the following pages.

Space Exploration Technologies, Inc. (SpaceX) and the United States Air Force (Air Force) reviewed all comments. Comments were addressed as detailed below.

Santa Barbara County Air Pollution Control District (SBAPCD)

The SBAPCD provided comments relating to local operational emissions significance thresholds, generator usage hours, and updates to National Ambient Air Quality Standards (NAAQS) and attainment status for Santa Barbara County. SpaceX shall coordinate with the SBAPCD to discuss permit requirements and identify issues and information needs as they relate to local significance thresholds. The EA was reviewed and updated as follows:

1. Resolved discrepancies relating to annual generator usage hours (Section 2.1.2.2 and Section 4.1.1.1).
2. Incorporated local threshold requirements per the SBCAPCD's New Source Review Regulation.
3. Revised Table 3-1 (Section 3.1) to update NAAQS Primary standard for 8-hour ozone.
4. Revised discussion relative to Santa Barbara County's attainment status to reflect the most current information.
5. Acknowledge receipt of comment regarding local significance thresholds that will be applicable during permit application process for the Falcon 9 and Falcon 9 Heavy programs from Space Launch Complex 4 East (SLC-4E).
6. Appendix A was not revised as the calculations were correctly done for two generators operating 336 hours annually each.

California Regional Water Quality Control Board – Central Coast Region (RWQCB)

The RWQCB submitted comments relating to the Installation Restoration Program (IRP) Site 8, the designation of Spring Canyon as having no beneficial uses per the Basin Plan, maintenance of vegetative cover to reduce stormwater runoff, and the Vandenberg Air Force Base (VAFB) Discharge to Grade Program. The EA was reviewed and updated as follows:

1. Revised Section 3.4.3 to reflect the current status of IRP Site 8 and remedial actions as recommended by RWQCB staff.
2. Revised Section 3.10.1 to reflect the correct designation of Spring Canyon as recommended by RWQCB staff and corrected the citation for the Basin Plan.

3. No changes were made to Section 4.2.1.1 relative to vegetative cover to prevent stormwater runoff. However, Section 4.10.2 of the EA indicates that the Stormwater Pollution Prevention Plan would include Best Management Practices for erosion and sediment controls. The Air Force has indicated that such measures would be reviewed and encouraged during the review of the construction project.
4. Revised Section 4.10.1.2 to indicate that wastewater discharges (stormwater and non-stormwater) would be managed in accordance with the National Pollutant Discharge Elimination System (NPDES) General Industrial Permit as well as the VAFB Discharge to Grade Program.

United Launch Alliance (ULA)

ULA submitted comments relative to the use of the Industrial Wastewater Treatment Plant (IWTP) on south VAFB and the number of truck trips required to bring propellant and fuels to SLC-4E in support of Falcon 9 and Falcon 9 Heavy launches. The EA was reviewed and updated as follows:

1. Revised Section 4.10.1.4 and other appropriate references throughout the EA to remove references to the IWTP as a disposal site for wastewater. The Air Force advised that this facility would not be available to SpaceX and they would be required to haul any wastewater that could not be discharged to grade to an appropriate industrial wastewater facility outside of VAFB. This requirement was also incorporated throughout the EA as appropriate.
2. Revised Section 4.1.1.2 to reflect a total of 312 annual truck trips to deliver fuel, propellants and components for support of a maximum of 10 annual launches. Emissions calculations for these delivery trucks have been added to the appropriate tables in this section as well as Appendix A.

Santa Barbara County
Air Pollution Control District

February 18, 2011

Paloma Nieto
30 CES/CEA
1028 Iceland Avenue
Vandenberg AFB, CA 93437-6610

Re: APCD Comments on Space Exploration Technologies' (SpaceX's) Final Draft Environmental Assessment (EA) for Falcon 9 and Falcon 9 Heavy Launch Vehicle Programs from Space Launch Complex 4 East (SLC-4E)

Dear Ms. Nieto:

The Air Pollution Control District (APCD) has reviewed the referenced Final Draft Environmental Assessment (EA) for the proposed project. The project consists of modifications to SLC-4E to accommodate and operate the Falcon 9 and Falcon 9 Heavy Launch vehicle programs for both government and commercial missions at Vandenberg Air Force Base, California. SLC-4E was previously used for the Titan IV program and has been non-operational since 2005. Demolition of existing facilities and structures, modifications of the existing site and structures, and new construction would occur as result of this project. Two acres of grading would be required. Two 200KVa electric generators powered by diesel engines will be installed for emergency back-up power during launch operations. Each generator is anticipated to operate for a maximum of 336 hours per year. The project includes the installation or reinstallation of propellant tanks. The Falcon 9 and Falcon 9 Heavy rockets use liquid oxygen (LOX) and highly refined kerosene, also known as rocket propellant -1 or refined petroleum-1 (RP-1), as propellants to carry payloads into orbit. SpaceX anticipates up to 10 launches per year.

APCD permits will be required for a number of project components. ***Therefore, APCD will be a lead agency under the California Environmental Quality Act (CEQA), and APCD permit actions will require CEQA review.*** When evaluating projects pursuant to CEQA, APCD staff compares project air pollutant emissions to APCD board-adopted CEQA significance thresholds (*Environmental Review Guidelines for the Santa Barbra County APCD*, revised November 2000, www.sbcapcd.org/apcd/landuse/htm#Guidelines). We note that the analyses and findings in the Draft EA are not based on APCD's CEQA significance thresholds. Additional CEQA analysis and documentation will be required, and such analysis must compare project emissions to APCD's CEQA significance thresholds and must also include an analysis of project impacts on global climate change. Analysis of climate change impacts should include quantification of project greenhouse gas (GHG) emissions, disclosure of impacts in the document, and mitigations of impacts as feasible.

The applicant is strongly advised to meet with District staff to discuss permit requirements and identify issues and information needs.

Key issues to be resolved during the CEQA and permitting process will include:

1. Diesel engines that are presented as "emergency generators" will be treated as prime engines under APCD permit and will require New Source Review (NSR) and the application of best available control technology (BACT).
2. The rated brake horsepower of the engines must be clarified.
3. The project will be required to undergo a screening level health risk assessment to demonstrate that a significant health risk will not occur.
4. Launch scenarios (including the occurrence of a successful and unsuccessful ("scrubbed") launch) will need to be addressed with equipment specifications, operational information, and a complete set of emissions calculations for each scenario.
5. The CEQA analysis will review the project for impacts in other issue areas (in addition to air quality) to assess whether environmental impacts will occur as a result of APCD's permit action.

Air Pollution Control District staff offers the following specific comments on the Final Draft EA:

1. **Chapter 2 Section 2.1.2.2 and Chapter 4 Section 4.1.1.1, Generator Usage Hours Discrepancy, Pages 2-13 and 4-3**: The total annual usage per generator listed in Table 2-3 on Page 2-13 as 336 annual hours, is in conflict with the discussion of generator operation on Page 4-3 which states that *"Each generator is anticipated to operate for a maximum of 672 hours per year..."*. Please verify the correct total hours of operation for each generator and correct this discrepancy in the document.

2. **Chapter 3, Affected Environment, Section 3.1.4, Local Requirements, Page 3-7**: It should also be noted that APCD's New Source Review Regulation established offset thresholds for operational emissions from new or modified stationary sources as follows (Rule 802, Section E.1, Table 3):
    - 55 pounds per day, or 10 tons per year, for nonattainment pollutants and precursors i.e., reactive organic compounds (ROC) or oxides of nitrogen (NO_X);
    - 80 pounds per day, or 15 tons per year, for particulate matter less than 10 microns (PM10); and,
    - 150 pounds per day, or 25 tons per year, for carbon monoxide (CO) if in nonattainment.

3. **Chapter 3, Affected Environment, Ambient Air Quality Standards, Page 3-3**: Please revise Table 3-1 to reflect the most current ambient air quality standards. Specifically, the Primary NAAQS for 8-hour Ozone is 0.075 ppm, not 0.08 ppm as cited.

4. **Chapter 3, Affected Environment, Attainment Status, Page 3-4**: Please revise the discussion of Santa Barbara County's attainment status to reflect the most current information. Santa Barbara County is only in non-attainment for the 8-hour ozone standard and in attainment for the 1-hour ozone standard.

5. **Chapter 4, Environmental Consequences, Section 4.1, Air Quality, Page 4-1**: The first paragraph of this section includes a bulleted list of air quality significance thresholds that are applied to the project. This section goes on to present the following threshold: *"To determine the significance of operational impacts, the federal major source thresholds for criteria pollutants of 100 tons per year, which is the major source thresholds under 40 CFR Part 70 (Federal Operating Permit*

Program), were used for all pollutants." This significance threshold of 100 tons per year does not correspond to SBCAPCD's board-adopted significance thresholds for operational emissions, which are as follows:

- emit (from all project sources, both stationary and mobile) less than the daily trigger for offsets or Air Quality Impact Analysis set in the APCD New Source Review Rule, for any pollutant (i.e., 240 pounds/day for ROC or NOx; and 80 lbs/day for PM10); and
- emit less than 25 pounds per day of NOx or ROC from motor vehicle trips only; and
- not cause or contribute to a violation of any California or National Ambient Air Quality Standard (except ozone); and
- not exceed the APCD health risk public notification thresholds adopted by the APCD Board (10 excess cancer cases in a million for cancer risk and a Hazard Index of more than one (1.0) for non-cancer risk ; and
- be consistent with the latest adopted federal and state air quality plans for Santa Barbara County.

Therefore, when the project is evaluated under CEQA with APCD acting as lead agency, different thresholds would be applied to the project to determine the significance of air quality impacts.

6. **Appendix A, Air Quality, Page A-9:** The operational emissions calculations for the emergency generator emissions are incorrect for carbon dioxide (CO2) if the operational hours of the emergency generators are 672 hours each per year. The cited number of 82.91 appears to be the emissions for only one generator in short tons. Please revise this table to include emissions from both emergency generators and convert to metric tons to match the units displayed in Table 4-3 on Page 4-6, which provides the annual greenhouse gas emissions under the proposed action and lists metric tons per year of CO2 from emergency generators.

Air Pollution Control District staff offers the following suggested conditions:

1. Standard dust mitigations (**Attachment A**) are recommended for all construction and/or grading activities. The name and telephone number of an on-site contact person must be provided to the APCD prior to issuance of land use clearance.

2. APCD Rule 345, *Control of Fugitive Dust from Construction and Demolition Activities*, became effective on July 21, 2010 and establishes new limits on the generation of visible fugitive dust emissions at demolition and construction sites. The rule includes measures for minimizing fugitive dust from on-site activities and from trucks moving on- and off-site. The text of the rule can be viewed on the APCD website at www.sbcapcd.org/rules/download/rule345.pdf.

3. Fine particulate emissions from diesel equipment exhaust are classified as carcinogenic by the State of California. Therefore, during project grading, construction, and hauling, construction contracts must specify that contractors shall adhere to the requirements listed in **Attachment B** to reduce emissions of ozone precursors and fine particulate emissions from diesel exhaust.

4. Prior to occupancy, APCD permits must be obtained for all equipment that requires an APCD permit. APCD Authority to Construct permits are required for diesel engines rated at 50 bhp and

greater (e.g., firewater pumps and emergency standby generators) and boilers/large water heaters whose combined heat input rating exceeds 2.0 million BTUs per hour.

5. All portable diesel-fired construction engines rated at 50 brake-horsepower or greater must have either statewide Portable Equipment Registration Program (PERP) certificates or APCD permits prior to operation. Construction engines with PERP certificates are exempt from APCD permit, provided they will be on-site for less than 12 months.

6. Applicant is required to complete and submit an Asbestos Demolition/Renovation Notification (APCD Form ENF-28 which can be downloaded at www.sbcapcd.org/eng/dl/dl08.htm) for each regulated structure to be demolished or renovated. Demolition notifications are required regardless of whether asbestos is present or not. The completed notification should be presented or mailed to the Santa Barbara County Air Pollution Control District with a minimum of 10 working days advance notice prior to disturbing asbestos in a renovation or starting work on a demolition. For additional information regarding asbestos notification requirements, please visit our website at www.sbcapcd.org/biz/asbestos.htm or contact us at (805) 961-8800.

7. At all times, idling of heavy-duty diesel trucks must be limited to five minutes; auxiliary power units should be used whenever possible. State law requires that drivers of diesel-fueled commercial vehicles:
   - shall not idle the vehicle's primary diesel engine for greater than 5 minutes at any location
   - shall not idle a diesel-fueled auxiliary power system (APS) for more than 5 minutes to power a heater, air conditioner, or any ancillary equipment on the vehicle.

8. Asphalt paving activities shall comply with APCD Rule 329, *Cutback and Emulsified Asphalt Paving Materials.*

If you or the project applicant have any questions regarding these comments, please feel free to contact me at (805) 961-8838 or via email at mmp@sbcapcd.org.

Sincerely,

Molly Pearson

Molly Pearson
Community Programs Supervisor
Technology and Environmental Assessment Division

Attachments: Fugitive Dust Control Measures
Diesel Particulate and NO_x Emission Measures

cc: Carly Wilburton
Michael Goldman
Ben Ellenberger
Project File
TEA Chron File

Santa Barbara County
Air Pollution Control District

ATTACHMENT A
FUGITIVE DUST CONTROL MEASURES

These measures are required for all projects involving earthmoving activities regardless of the project size or duration. Proper implementation of these measures is assumed to fully mitigate fugitive dust emissions.

- During construction, use water trucks or sprinkler systems to keep all areas of vehicle movement damp enough to prevent dust from leaving the site. At a minimum, this should include wetting down such areas in the late morning and after work is completed for the day. Increased watering frequency should be required whenever the wind speed exceeds 15 mph. Reclaimed water should be used whenever possible. However, reclaimed water should not be used in or around crops for human consumption.

- Minimize amount of disturbed area and reduce on site vehicle speeds to 15 miles per hour or less.

- If importation, exportation and stockpiling of fill material is involved, soil stockpiled for more than two days shall be covered, kept moist, or treated with soil binders to prevent dust generation. Trucks transporting fill material to and from the site shall be tarped from the point of origin.

- Gravel pads shall be installed at all access points to prevent tracking of mud onto public roads.

- After clearing, grading, earth moving or excavation is completed, treat the disturbed area by watering, or revegetating, or by spreading soil binders until the area is paved or otherwise developed so that dust generation will not occur.

- The contractor or builder shall designate a person or persons to monitor the dust control program and to order increased watering, as necessary, to prevent transport of dust offsite. Their duties shall include holiday and weekend periods when work may not be in progress. The name and telephone number of such persons shall be provided to the Air Pollution Control District prior to land use clearance for map recordation and land use clearance for finish grading of the structure.

  Plan Requirements: All requirements shall be shown on grading and building plans and as a note on a separate information sheet to be recorded with map. **Timing**: Requirements shall be shown on plans or maps prior to land use clearance or map recordation. Condition shall be adhered to throughout all grading and construction periods.

  MONITORING: Lead Agency shall ensure measures are on project plans and maps to be recorded. Lead Agency staff shall ensure compliance onsite. APCD inspectors will respond to nuisance complaints.

Santa Barbara County
Air Pollution Control District

ATTACHMENT B
DIESEL PARTICULATE AND NO_x EMISSION MEASURES

Particulate emissions from diesel exhaust are classified as carcinogenic by the state of California. The following is an updated list of regulatory requirements and control strategies that should be implemented to the maximum extent feasible.

The following measures are required by state law:

- All portable diesel-powered construction equipment shall be registered with the state's portable equipment registration program OR shall obtain an APCD permit.

- Fleet owners of mobile construction equipment are subject to the California Air Resource Board (CARB) Regulation for In-use Off-road Diesel Vehicles (Title 13 California Code of Regulations, Chapter 9, § 2449), the purpose of which is to reduce diesel particulate matter (PM) and criteria pollutant emissions from in-use (existing) off-road diesel-fueled vehicles. For more information, please refer to the CARB website at www.arb.ca.gov/msprog/ordiesel/ordiesel.htm.

- All commercial diesel vehicles are subject to Title 13, § 2485 of the California Code of Regulations, limiting engine idling time. Idling of heavy-duty diesel construction equipment and trucks during loading and unloading shall be limited to five minutes; electric auxiliary power units should be used whenever possible.

The following measures are recommended:

- Diesel construction equipment meeting the California Air Resources Board (CARB) Tier 1 emission standards for off-road heavy-duty diesel engines shall be used. Equipment meeting CARB Tier 2 or higher emission standards should be used to the maximum extent feasible.

- Diesel powered equipment should be replaced by electric equipment whenever feasible.

- If feasible, diesel construction equipment shall be equipped with selective catalytic reduction systems, diesel oxidation catalysts and diesel particulate filters as certified and/or verified by EPA or California.

- Catalytic converters shall be installed on gasoline-powered equipment, if feasible.

- All construction equipment shall be maintained in tune per the manufacturer's specifications.

- The engine size of construction equipment shall be the minimum practical size.

- The number of construction equipment operating simultaneously shall be minimized through efficient management practices to ensure that the smallest practical number is operating at any one time.

- Construction worker trips should be minimized by requiring carpooling and by providing for lunch onsite.

  Plan Requirements: Measures shall be shown on grading and building plans. **Timing:** Measures shall be adhered to throughout grading, hauling and construction activities.

  MONITORING: Lead Agency staff shall perform periodic site inspections to ensure compliance with approved plans. APCD inspectors shall respond to nuisance complaints.

California Regional Water Quality Control Board
Central Coast Region

895 Aerovista Place, Suite 101, San Luis Obispo, California 93401-7906
(805) 549-3147 • FAX (805) 543-0397
http://www.waterboards.ca.gov/centralcoast

Linda S. Adams
Acting Secretary for
Environmental Protection

Edmund G. Brown Jr.
Governor

February 16, 2010

Ms. Paloma Nieto **Via Regular and Electronic Mail**
Paloma.nieto@mantech.com
30 CES/CEA
1028 Iceland Avenue
Vandenberg Air Force Base, CA 93437-6010

Dear Ms. Nieto:

DoD – VANDENBERG AIR FORCE BASE (VAFB); SPACE LAUNCH COMPLEX 4–EAST (SLC-4E) – COMMENT LETTER, SPACE EXPLORATION TECHNOLOGIES' ENVIRONMENTAL ASSESSMENT FOR FALCON 9 AND FALCON 9 HEAVY LAUNCH VEHICLE PROGRAMS

Central Coast Regional Water Quality Control Board (Water Board) staff reviewed the February 1, 2011 *Final Draft Environmental Assessment, Falcon 9 and Falcon 9 Heavy Launch Vehicle Programs from SLC-4E* (EA), received February 3, 2011. ManTech SRS Technologies, Inc. (ManTech) prepared and distributed this EA on behalf of Space Exploration Technologies, Inc. (SpaceX).

Background:
SLC-4E is located on south VAFB, was previously used for the Atlas/Agena and Titan launch programs, and has been non-operational since 2005. SpaceX proposes modifications and additions to SLC-4E infrastructure in order to operate its Falcon 9 and Falcon 9 Heavy launch programs. SpaceX chose VAFB for implementation of these programs due to its proximity to SpaceX's southern-California operations, its unique location along the Pacific coast that provides the ability to launch payloads into polar and sun-synchronous inclinations, and specifically chose the SLC-4E facility because of its existing, underutilized infrastructure.

SpaceX's Falcon 9 and Falcon 9 Heavy launch programs are designed to provide commercial and government space operations from VAFB, with up to 10 launches per year. The launch vehicles use liquid oxygen and highly refined kerosene fuel (RP-1) as propellants to lift payloads into orbit.

The EA describes SpaceX's Proposed Action, which entails modifications/additions to SLC-4E and operation of the Falcon 9 and Falcon 9 Heavy launch programs. Modifications for accommodating the programs include demolition of some existing facilities (addressed under a prior environmental assessment [USAF 2005]), infrastructure modifications, and new construction. Planned infrastructure modifications include improvements to the administrative building, installation of propellant tanks, re-installation/re-initiation of utilities, resurfacing the launch water deluge drainage and retention basin, resurfacing the entrance road and refurbishment of the security system, if required.

New construction planned by SpaceX includes a new integration and processing hangar. The hangar-related construction footprint will entail approximately 30,000 square feet of space, plus 7,500 square feet of paved area for vehicle maneuvering and a 20-foot wide by 250-foot long access road by the side of the hangar.

The EA identifies and analyzes the affected environmental consequences of implementing the Proposed Action. The EA concludes that with implementation of the environmental protection and monitoring measures identified in the EA, no significant impact or adverse effects should result, and/or, in the case of air quality and biological resources, environmental consequences have the potential to result in less than significant impacts to the environment.

Through implementation of VAFB's Installation Restoration Program (IRP), a program that identifies, characterizes and restores contaminant release sites at VAFB, Water Board staff has familiarity with SLC-4E, which is also known as IRP Site 8. Past launch-related activities at SLC-4E/Site 8 resulted in release of wastes to soil and groundwater. The Air Force has identified and is remediating several wastes in Site 8 groundwater, most notably perchlorate, trichloroethene (TCE), and TCE's degradation compounds cis-1,2-dichloroethene and vinyl chloride.

Water Board staff's comments regarding the EA are provided below.

Comments:

1. **Section 3.4.3, page 3-25; Installation Restoration Program.** Section 3.4.3 of the EA describes the VAFB IRP and gives a brief overview of IRP Site 8 related contamination and remediation. The second to last sentence in the second to last paragraph incorrectly states that there is a dual-phase extraction system installed at Site 8. The only dual-phase extraction in the general vicinity of Site 8 was located at the adjacent Space Launch Complex–4 West (SLC-4W; IRP Site 9). In addition, operation of this dual-phase extraction system ended in 2006. SpaceX must modify the second to last sentence in the second to last paragraph by removing mention of the dual-phase extraction system that was actually deployed at SLC-4W rather than SLC-4E.

   In September 2006, the Air Force initiated implementation of an *in-situ* bioremediation (ISB) substrate injection pilot test program for treatment of TCE and perchlorate impacted groundwater at Site 8/SLC-4E. Based on success of this pilot test, the ISB treatment system was expanded to a full-scale interim remedial action in February 2008.

   Groundwater monitoring related to the ISB treatment system and related to the over-all groundwater contaminant plume footprint is on-going. In addition, the need for additional ISB substrate injection events at Site 8/SLC-4E can not be ruled out at this time. As a result, any future infrastructure modifications and operations at SLC-4E must accommodate IRP groundwater monitoring and remediation activities. SpaceX must modify Section 3.4.3 of the EA to reflect the on-going nature of the IRP Site 8 monitoring and remediation, and to describe accommodation for on-going IRP Site 8 monitoring and remediation activities (e.g., access to groundwater monitoring wells, access to injection wells for remediation system operations and maintenance, and eventual proper abandonment/destruction of select monitoring wells and injection wells). This accommodation could be described in Section 4.4.1, page 4-17.

The ultimate goal of groundwater remediation at Site 8/SLC-4E is to return the groundwater to conditions consistent with beneficial uses, as prescribed in the Water Board's 1994 Water Quality Control Plan, Central Coast Region (Basin Plan).

2. **Section 3.10.1, page 3-36, Surface Water.** In the last sentence of this section, the EA states "Spring Canyon [Creek] has no designated beneficial uses identified in the Basin Plan." However, the introductory paragraphs of the Beneficial Uses section in the Basin Plan states, "Surface water bodies within the Region that do not have beneficial uses designated for them in Table 2-1 are assigned the following designations:

   - Municipal and Domestic Water Supply
   - Protection of both recreation and aquatic life.

   Space X must revise the EA's Surface Water section to indicate these Beneficial Uses for Spring Canyon Creek. The EA must also indicate the construction and operational activities at SLC-4E in support of the Space X program must protect the Water Quality Objectives associated with these Beneficial Uses.

   Additionally, this EA paragraph references a citation to SWRCB 2010, which is an internet site. The reference should more properly cite the Basin Plan as listed in the citations at the end of this comment letter.

3. **Section 4.2.1.1, page 4-9 and 4-10, Maintaining Vegetative Cover Relative to Stormwater Runoff.** Water Board staff recommends that SpaceX's vegetation management practices encourage sustainable plant coverage in unpaved areas, for the purpose of minimizing soil erosion, maximizing sediment retention, and maximizing stormwater infiltration. It is Water Board staffs understanding that this is consistent with Section 438 of the Energy Independence and Security Act of 2007 and VAFB's Storm Water Management Program (SWMP). Similarly, if deluge water discharge to grade is permitted (see Comment 4 below), adequate vegetation coverage will provide the same beneficial effect.

4. **Section 4.10.1.2, page 4-28, Discharge to Grade Program.** The EA's second paragraph in Section 4.10.1.2 introduces the VAFB "Discharge to Grade Program." The Water Board regulates discharges to land by issuing waste discharge requirements (WDRs) and discharges to water by issuing WDRs/National Pollutant Discharge Elimination System (NPDES) permits. The Water Board has issued VAFB SLC-specific NPDES permits for deluge water and stormwater discharges to surface water. Although this program is mentioned in the Base's SWMP, current Water Board staff is not familiar with the VAFB "Discharge to Grade Program", and assumes that the EA should instead refer to the site-specific NPDES permits for VAFB SLCs.

   SpaceX must obtain an NPDES permit from the Water Board, and fully implement the permit's requirements, in association with discharge of deluge water from the SLC-4E deluge retention basin system, and in association with SLC-4E stormwater.

Water Board staff appreciates the opportunity to review and comment on the Final Draft EA, and look forward to successful deployment of the Falcon 9 and Falcon 9 Heavy launch programs. If you have questions regarding this letter regarding soil and groundwater waste cleanup, please call **Don Eley (805) 542-4626** (email DEley@waterboards.ca.gov). If you have questions regarding stormwater NPDES permits, please contact **David Innis (805) 549-3150** (email DBInnis@waterboards.ca.gov). If you have general questions regarding WDRs or NPDES permits, please contact **Sheila Soderberg (805) 549-3592** (email ssoderberg@waterboards.ca.gov).

Sincerely,

Roger W. Briggs
Executive Officer

S:\DoD\DoD Facilities\Vandenberg\Correspondence\Sites\8C\8\Site 8C SLC-4E Final Draft Environ Assess commnt ltr.doc

Paper copies:
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VAFB, CA 93437-6010

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Electronic copies via email:

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REFERENCES:

State Water Resources Control Board (SWRCB) and Regional Water Quality Control Board (RWQCB), Central Coast Region. 1994. *Water Quality Control Plan, Central Coast Region* (Basin Plan) (with amendments though May 9, 2008).

United States Air Force (USAF), 2005. *Final Programmatic Environmental Assessment Demolition and Abandonment of Atlas and Titan Facilities, Vandenberg Air Force Base*, *California*. September 13.

United Launch Alliance
DZ31-L480-REC-L-11-0011
17 February 2011

SUBJECT: COMMENTS TO FINAL DRAFT EA FOR THE FALCON 9 AND FALCON 9 HEAVY LAUNCH VEHICLE PROGRAMS FROM SPACE LAUNCH COMPLEX 4 EAST

TO: CONSERVATION PROGRAM MANAGER
MANTECH SRS TECHNOLOGIES, INC.
102 EAST OCEAN AVENUE
LOMPOC, CA 93436

ATTN.: PALOMA NIETO

United Launch Alliance is pleased to offer the following comments regarding the Final Draft Environmental Assessment for the Falcon 9 and Falcon 9 Heavy Launch Vehicle Programs from Space Launch Complex 4 East, dated 1 February 2011.

1) Per Section 4.10.1.4, "Water Resources":

"Water containing prohibited chemical levels would be removed and hauled to the industrial wastewater treatment ponds.."

Comment: These wastewater treatment ponds (otherwise known as the IWTP) are actually water evaporation ponds and are located on Road N south of SLC-6. Per the Atlas and Delta EELV CSOSA Annex B documents, ULA facilities are prohibited from using them. The language below appears in the current 2004 version and also the proposed 2009 version of the EELV CSOSA Annex Bs:

"4.5.2. Industrial waste - The Industrial Wastewater Treatment Plant (IWTP) is operated under a waiver from the Regional Water Board. It is not available to commercial operators...."

Allowing Space X to use these ponds provides an unfair economic advantage to Space X, a direct competitor to ULA. The ponds should either be prohibited for all or available to all."

2) Per Section 4.9.1.2, "Falcon 9 and Falcon 9 Heavy Launch Operations"

"Additionally, approximately once per week, a fuel truck, LOX truck and helium truck would bring supplies resulting in up to 24 round trip visits to the site over an 8-week period"

Comment: On page 2-8 of the EA, large storage tanks containing 250,000 gallons of LOX and 100,000 gallons of RP-1 are described. These large tanks are not on-site at this time, and are described as future capability. Assuming LOX and RP-1 tanker transportation trucks have a capacity of 4500 gallons per truck, 78 truck trips would be required to fill the combined volume of these two tanks the first time, which will then need to be

replenished depending on the launch rate and the LOX boil-off rate. This is considerably more than the total of 24 trips described in section 4.9.1.2 (3 trucks per week times 8 weeks for each launch). Helium is being brought up in tankers and is not stored in a separate tank on site, adding another 8 trucks per launch. Most transportation tanker trucks are diesel powered.

This heavy vehicle traffic is not accounted for in the air emissions calculations in Appendix A, "Air Quality". Heavy truck emissions are only calculated for the construction phase of the Program, but are not quantified for the operational phase. The only vehicle emissions calculated for the operational phase are for permanent and transient employees.

The emission calculations need to be amended to include all heavy transportation vehicles used during the operational phase, including those owned by Space X and operated by employees to support launch operations.

This concludes comments provided by United Launch Alliance regarding the Draft Falcon 9 Environmental Assessment.

If you have any questions, please do not hesitate to call Rhonda Cardinal at (805) 606-6340 x6566.

Sincerely,

Rhonda Cardinal

Rhonda Cardinal
Engineer/Scientist Environmental
Safety, Health, and Environmental Affairs
Delta II/IV Launch Operations
Vandenberg AFB, CA

REC/imk

Cc: Harley T. Santos- Jr.- Mantech Intl.
Cindy Green- United Launch Alliance
James Boyle- United Launch Alliance
Rick Beach- United Launch Alliance
Martin Walsh- United Launch Alliance
James Denapoli- United Launch Alliance
Mark Inguaggiato- United Launch Alliance

APPENDIX D:

Regulatory Consultation

United States Department of the Interior

FISH AND WILDLIFE SERVICE
Ventura Fish and Wildlife Office
2493 Portola Road, Suite B
Ventura, California 93003

IN REPLY REFER TO:
81440-2011-F-0379

June 24, 2011

Beatrice L. Kephart
30 CES/CEANC
1028 Iceland Avenue
Vandenberg Air Force Base, California 93437

Subject: Reinitiation of the Biological Opinion for the Modification and Operation of Space Launch Complex 4 East for the Falcon 9 Space Vehicle Program at Vandenberg Air Force Base, Santa Barbara County, California (8-8-11-F-32R)

Dear Ms. Kephart:

This document transmits the U.S. Fish and Wildlife Service's (Service) biological opinion based on our review of the modification and operation of Space Launch Complex 4 East (SLC-4E) for the Falcon 9 Space Vehicle program at Vandenberg Air Force Base (VAFB) and its effects on the federally endangered El Segundo blue butterfly (*Euphilotes battoides allyni*). You requested concurrence that the modification and operation of SLC-4E may affect, but is not likely to adversely affect the federally endangered California least tern (*Sterna antillarum browni*) and southern sea otter (*Enhydra lutris nereis*), and the federally threatened western snowy plover (*Charadrius alexandrinus nivosus*). Your initial request, dated July 1, 2010, was received in our office on July 6, 2010; however, in a letter, dated May 25, 2011, and received in our office on May 26, 2011, you requested to amend the biological opinion and change your determination of no effect to the California red-legged frog to may affect, but not likely to adversely affect the California red-legged frog. Your requests and our responses are in accordance with section 7 of the Endangered Species Act of 1973, as amended (Act)(16 U.S.C. 1531 et seq.).

California Least Tern

We concurred with your determination that the proposed activities may affect but are not likely to adversely affect the California least tern because SLC-4E is 7.5 miles south of the species' breeding site at Purisima Point and approximately 4 miles south of its foraging site at the Santa Ynez River mouth. Launch activities from VAFB have resulted in California least terns emigrating from their breeding site when a launch occurred within 0.5 mile of the breeding site. Depending upon when the launch activity occurs related to the stage California least terns are in their nesting cycle seems to have different effects. At the beginning of the nesting season adults tend to be more readily disturbed, but once serious courtship and nest-building begins the adults are more tenacious. We determined that even though some launches have caused adverse effects to the California least tern, SLC-4E is far enough away that the launches are not likely to adversely affect this species. To help define the effects further, the Air Force proposes to

monitor the California least terns at their breeding and foraging sites for the first launch of any Falcon 9 vehicle from SLC-4E, if terns are present.

Southern Sea Otter

We concurred with your determination that the proposed activities may affect but are not likely to adversely affect the southern sea otter because the U.S. Air Force's (Air Force) monitoring indicates launch noise and security overflights do not substantially affect the number or activities of this species in the near shore marine environments of VAFB.

Western Snowy Plover

We concurred with your determination that the proposed activities may affect, but are not likely to adversely affect, the western snowy plover because monitoring data obtained since 1995 has consistently concluded that western snowy plovers may crouch and observe objects such as helicopters or launch vehicles, and flush at launch but soon return to normal behavior. No evidence of injury, mortality, or post-launch abnormal behavior of any monitored western snowy plovers has been observed. Startle responses are rare and reproductive success does not seem to be affected by launch activities, even near SLC-2 where Delta II vehicles are launched within approximately 0.5 mile of nesting snowy plovers.

California Red-legged Frog

We concur with your determination that the proposed activities may affect, but is not likely to adversely affect the California red-legged frog because California red-legged frogs would likely treat disturbance caused by elevated noise in much the same way as they respond to the approach of a potential predator, by diving and remaining below the water's surface. Water would attenuate high-decibel sound to some degree. Similarly, California red-legged frogs that are exposed to light flashes from launch activities may also react by diving into water. In addition, previous water quality monitoring data has shown that the pH did not substantially change as a result of launches. For instance, Honda Creek has been monitored pre- and post-launch of Titan II, Titan IV, and Delta II launch vehicles and no adverse effects have been documented. At other sites at which similar solid rocket motors are used, most of the component in the ground cloud that is formed at ignition (aluminum oxide and hydrogen chloride) would be expected to fall from the cloud to the land surface within several hundred feet of the launch complex. The nearest California red-legged frogs occur in the Bear Creek lagoon, which is just over 1 mile north of the launch overpressure zone, and in Cañada Honda Creek more than 2 miles south of SLC-4E.

This biological opinion was prepared using information provided in your request for formal consultation, electronic and telephone communications between our staffs, and information in our files. A complete administrative record for this biological opinion is available at the Ventura Fish and Wildlife Office.

CONSULTATION HISTORY

Space Launch Complex-4 was originally constructed to launch Atlas/Agena missiles for the Point Arguello Naval Station. In 1966, the Air Force assumed responsibility for the complex and continued to launch Atlas/Agena vehicles. In 1971, SLC-4E began service as a component of the Titan launch program. A total of 65 vehicles have been launched from SLC-4E to date, but the site was decommissioned in the summer of 2005 following the final Titan launch. We have previously consulted on the Titan Space Launch program at SLC-4 (1-6-88-F-53, 1-8-96-F/C-29). We also previously consulted on activities relating to the maintenance of base wide firebreak maintenance and fire access roads (1-8-06-F-43), which included a network of firebreaks and fire access roads around the exterior of SLC-4.

On December 10, 2010, we issued a biological opinion for the operation and modification of SLC-4E for the Falcon 9 launch program. On May 25, 2011, you requested to amend the biological opinion and change the determination of no effect to California red-legged frog to a determination of may affect, but not likely to adversely affect the California red-legged frog. The Air Force requested to change the determination because California red-legged frog could be adversely affected by elevated noise levels, light flashes, and acidic emissions created by launch operations.

BIOLOGICAL OPINION

DESCRIPTION OF THE PROPOSED ACTION

The Air Force proposes to modify SLC-4E for the new Falcon 9 and Falcon 9 Heavy Space Vehicle Program at VAFB. The Falcon launch program is part of a commercial venture by SpaceX to provide high reliability with relatively low costs and is needed to fulfill the goal of the National Transportation Policy to achieve affordable access to space. Both the Falcon 9 and Falcon 9 Heavy programs would launch vehicles that are two-stage medium to heavy-lift vehicles designed to place large to very large payloads in orbit.

The project site includes the entire SLC-4E complex, including a 300-foot launch overpressure zone that buffers the interior portion of SLC-4E. Space Launch Complex-4E would be modified to support the Falcon 9 launch program, which includes demolishing several existing facilities, constructing a new prefabricated steel-sided integration and processing hangar, improving administrative buildings, reinstalling utilities, and resurfacing the launch water deluge drainage and retention basin and the entrance road. The exact modifications to the existing facilities, roads, and utilities would be determined after a detailed site inspection. The project is expected to last approximately 24 months. The proposed activities would be restricted to areas inside or near previously disturbed areas of SLC-4E and the entrance road.

Approximately 30,000 and 80,000 gallons of water would be discharged during a Falcon 9 and Falcon 9 Heavy launch activity, respectively. The water not vaporized during the launch would be contained in a concrete-lined retention basin and subsequently disposed of off base at an

approved wastewater facility or discharged to grade. The ground cloud at liftoff would not contain hazardous materials. During the rainy season, the retention basin would be pumped dry when water levels exceed 6 inches. Regular pumping would keep the water levels low in order to maintain a safer work site and minimize the usage for California red-legged frogs. Sediment in the basin would be removed annually to improve water quality and reduce wear on the pump.

Fire is anticipated to be restricted to the area of the launch plume. In addition, fire suppression activities are designed to reduce the potential for a fire and limit its spread. All grassy areas within SLC-4E would be mowed biweekly or as needed, including up to 30-feet beyond the outer fence to meet security and fire suppression requirements.

As part of the project, the Air Force would implement the following minimization measure to minimize the adverse effects to the El Segundo blue butterfly:

- Seacliff buckwheat (*Eriogonum parvifolium*) plants will be flagged and avoided, including a 2-foot buffer around each plant, as long as avoidance of the plant(s) does not preclude program operation needs;

- A biological monitor will be on-site to help ensure the adverse effects to seacliff buckwheat plants are minimized; and

- The Air Force will replace seacliff buckwheat plants at a 1:5 ratio (plants affected to plants restored) at a location determined by a VAFB biologist.

ANALYTICAL FRAMEWORK FOR THE JEOPARDY DETERMINATION

The jeopardy analysis in this biological opinion relies on four components: (1) the *Status of the Species*, which evaluates the range-wide condition of the El Segundo blue butterfly, the factors responsible for that condition, and the species' survival and recovery needs; (2) the *Environmental Baseline*, which evaluates the condition of the El Segundo blue butterfly in the action area, the factors responsible for that condition, and the relationship of the action area to the survival and recovery of the El Segundo blue butterfly; (3) the *Effects of the Action*, which determines the direct and indirect impacts of the proposed Federal action and the effects of any interrelated or interdependent activities on the El Segundo blue butterfly; and (4) the *Cumulative Effects*, which evaluates the effects of future, non-Federal activities in the action area on the El Segundo blue butterfly.

In accordance with policy and regulation, the jeopardy determination is made by evaluating the effects of the proposed Federal action in the context of the current status of the El Segundo blue butterfly, taking into account any cumulative effects, to determine if implementation of the proposed action is likely to cause an appreciable reduction in the likelihood of both the survival and recovery of the El Segundo blue butterfly in the wild.

The jeopardy analysis in this biological opinion places an emphasis on consideration of the range-wide survival and recovery needs of the El Segundo blue butterfly and the role of the action area in the survival and recovery of the El Segundo blue butterfly as the context for evaluating the significance of the effects of the proposed Federal action, taken together with cumulative effects, for purposes of making the jeopardy determination.

STATUS OF THE SPECIES

The El Segundo blue butterfly was federally listed as endangered on June 1, 1976 (41 FR 22041). Critical habitat for the subspecies has not been designated. We issued a recovery plan for the El Segundo blue butterfly on September 28, 1998 (Service 1998). The El Segundo blue butterfly was formally described by Oakley Shields (1975) based on specimens that had been collected in the city of El Segundo, California.

The El Segundo blue butterfly is in the family Lycaenidae. It is one of five subspecies comprising the polytypic species, the square-spotted blue butterfly *(Euphilotes battoides)*. Like all species in the genus *Euphilotes*, the El Segundo blue butterfly spends its entire life cycle in intimate association with a species of buckwheat, in this case seacliff buckwheat. However, the nearly complete association of all life stages with a single plant is unique among North American butterflies. El Segundo blue butterfly adults mate, nectar, lay eggs, perch, and in most cases probably die on flower heads (Mattoni 1990).

The adult stage of the El Segundo blue butterfly begins in early June and concludes in early to mid-September. The onset of this stage is closely synchronized with the beginning of the flowering season for seacliff buckwheat (Mattoni 1990). Typically, adult females survive up to 2 weeks whereas a male may survive up to 7 days (G. Pratt, Department of Entomology, University of California Riverside, pers. comm. 2006a). Upon emergence as adults, females fly to seacliff buckwheat flower heads where they mate with males that are constantly moving among flower heads (Service 1998). Eggs hatch within 3 to 5 days. The larvae then undergo four instars to complete growth, a process that takes 18 to 25 days (Service 1998b). By the third instar, the larvae develop honey glands, and are thereafter usually tended by ants (e.g., *Iridiomyrmex humilis*, *Conomyrmex* spp.), which may protect them from parasitoids (e.g., Branchoid wasp (*Cortesia* spp.)) and small predators (Mattoni 1990). The larvae remain concealed within flower heads and initially feed on pollen, then switch to feeding on seeds sometime during the first and second instar (Pratt, pers. comm. 2006a). Larvae are highly polymorphic, varying from almost pure white or yellow to strikingly marked individuals with a dull red-to-maroon background broken by a series of yellow or white dashes (Mattoni 1990). By September, seacliff buckwheat plants have generally senesced and the larvae fall or crawl to the ground and diapause in the soil. They emerge as adults the following June. Some pupae may remain in diapause for 2 or more years (Service 1998). At least 0.5 inch of rain must penetrate the soil to accumulate enough moisture for the pupae to undergo a life stage change (Pratt, pers. comm. 2006a).

Population dynamics of this species are closely allied with the seacliff buckwheat. Although individual plants may live 20 years or more, young plants generally do not flower until their second year of growth (Arnold and Goins 1987). Juveniles and older plants do not produce as many flowers as middle-aged buckwheat plants, which support the most butterflies (Arnold and Goins 1987). Field observations suggest that most solitary buckwheat plants less than about 5 years of age do not produce enough flowers for larvae to effectively utilize them (Arnold 1983). Thus, survival of the El Segundo blue butterfly is dependent upon maintenance of middle-aged buckwheat plants, plus recruitment of younger plants to replace older individuals that senesce.

The range of seacliff buckwheat is greater than the known range of the El Segundo blue butterfly; seacliff buckwheat occurs from San Diego County to the northern end of Monterey County (Pratt, pers. comm. 2006b). However, the southern extent of the El Segundo blue butterfly's known distribution is Malaga Cove in Los Angeles County; before 2005 when the butterfly was discovered in Santa Barbara County, the northern extent of the subspecies' known distribution was the Ballona Wetlands, which is also in Los Angeles County. The El Segundo blue butterfly appears further limited to areas with high sand content (Service 1998).

In general, the El Segundo blue butterfly is negatively impacted by competition with non-native vegetation; competition, predation, and parasitism by other insects utilizing seacliff buckwheat; and habitat fragmentation. Relatively fast-growing exotics such as acacia (*Acacia* spp.), iceplant, other buckwheat species (*Eriogonum* spp.), and non-native grasses compete with seacliff buckwheat by inhibiting seedlings from sprouting and maturing to juveniles (Mattoni 1990). Pratt (1987) observed numerous insects living in seacliff buckwheat inflorescences along with El Segundo blue butterfly larvae, including lepidopterous larvae in the families of Cochylidae, Gelechiidae, Geometridae, Riodinidae, and even other Lycaenidae.

Habitat fragmentation is detrimental to small, isolated populations and produces edge effects that facilitate the introduction of invasive plant species that can out-compete and displace seacliff buckwheat. Urbanization and land conversion have fragmented the historic range of the El Segundo blue butterfly such that extant populations now operate as independent units rather than parts of a metapopulation or a single, cohesive, wide-ranging population. Small populations have higher probabilities of extinction than larger populations because their low abundance renders them susceptible to inbreeding, loss of genetic variation, high variability in age and sex ratios, demographic stochasticity, and other random, naturally occurring events such as droughts or disease epidemics (Soulé 1987). Isolated populations are more susceptible to elimination by stochastic events because the likelihood of recolonization following such events is negatively correlated with the extent of isolation (Wilcox and Murphy 1985). Given the low dispersal potential of El Segundo blue butterflies, it is unlikely that this subspecies will naturally recolonize a site.

For several decades following the subspecies' description, the El Segundo blue butterfly was presumed to be endemic to southwestern Los Angeles County in coastal southern California. Museum records reveal that the El Segundo blue butterfly was once widespread on the El Segundo sand dunes and specimens were collected at El Segundo, Redondo Beach, Manhattan

Beach, and at several locations on the Palos Verdes peninsula (Donahue 1975). There are known populations at four locations in Los Angeles County: the Ballona Wetlands, the Airport Dunes, the Chevron Preserve, and Malaga Cove. Four recovery units, based on geographic proximity, habitat similarity, and possible genetic exchange, encompass these areas with the known populations and (or) areas with restorable habitat (Service 1998).

Population in Santa Barbara County

The El Segundo blue butterfly was reported to occur at VAFB in 2005 by Dr. Gordon Pratt and by Dr. Pratt and Dr. Richard Arnold in 2007 (Pratt, pers. comm. 2006a; E. Bell, Vandenberg Air Force Base biologist, pers. comm. 2007), although it is not absolutely clear whether the individuals observed at VAFB are actually the El Segundo blue butterfly or morphologically similar species. Clarifying the taxonomic status of these populations is not trivial as *Euphilotes* is a diverse genus with known cryptic speciation (i.e., some species are very similar morphologically) (Mattoni 1988). Wing characters are notoriously unreliable due to individual variability so single individuals usually cannot be confidently determined without other clues such as location, flight season, and larval host plant (G. Ballmer, Department of Entomology, University of California Riverside, pers. comm. 2006). Given the geographic separation between VAFB and the El Segundo Dunes (approximately 120 miles) and the relatively limited dispersal capability of El Segundo blue butterflies, it is possible that the butterflies observed at VAFB are not El Segundo blue butterflies but rather an undescribed species. Conversely, it is also possible that suitable habitat for the El Segundo blue butterfly was once contiguous from the El Segundo sand dunes to Santa Barbara County and has been displaced in some areas by development and other anthropogenic causes resulting in a disjunction in the species' distribution. Based on wing morphology, flight period, genitalia, and host plant association; these individuals were determined to be more similar to the El Segundo blue butterfly than to any other known *Euphilotes battoides* group taxon (Ballmer, pers. comm. 2006; Pratt, pers. comm. 2006c).

Butterflies in the genus *Euphilotes* can be very similar morphologically yet significantly different genetically (Mattoni 1990; Pratt 1994). To try to conclusively determine the identity of these butterflies, individual male butterflies were collected to compare the genetic signatures among the butterflies from VAFB with known El Segundo blue butterflies. We have reviewed the results of the genetic study and determined that the resulting information was not conclusive enough to make a determination that the butterfly in question is not the El Segundo blue butterfly. Therefore, we consider this species to be the El Segundo blue butterfly until we receive definitive information demonstrating otherwise.

Based on the most recent surveys conducted at VAFB in 2010, the Air Force observed 361 El Segundo blue butterflies; 217 on North Base and 145 on South Base. In 2009, 329 butterflies were observed; 154 on North Base and 175 on South Base. Arnold (1986) conducted capture-recapture studies in Los Angeles County and reported that the majority of El Segundo blue butterflies moved 100 feet or less between captures; 79 percent and 87 percent for females and males, respectively. Approximately 93 percent of females and males moved 200 feet or less, and only 3 percent of females and 4 percent of males moved more than 500 feet. The farthest

distance moved by any individual butterfly was approximately 7,200 feet (1.36 miles). Therefore, taking into account that the vast majority of individual El Segundo blue butterflies move 200 feet or less, calculating a 200-foot buffer around each known occupied location produces a figure of approximately 801 acres of known occupied habitat at VAFB (Air Force 2010).

It is worth noting, however, that the 200-foot buffer was derived from studies at the Chevron Refinery in El Segundo. This preserve is 1.5 acres and is completely surrounded by urban areas. The area contains high concentrations of seacliff buckwheat plants that grow in close proximity to one another. Therefore, the adult butterflies would not have to disperse very far to locate suitable buckwheat flower heads. In contrast, the preserve at the Los Angeles International Airport is 200 acres and contains widely scattered seacliff buckwheat plants. At this site, El Segundo blue butterflies were detected dispersing up to 1.4 miles (Arnold 1986). Additionally, adult butterflies dispersed up to 0.5 mile from occupied locations to colonize restoration sites in Los Angeles and Redondo Beach. Because the El Segundo blue butterfly has been observed to disperse farther distances in larger areas that contain more widely scattered plants, such as VAFB, the 200-foot buffer may represent the lower end of the dispersal distance capability of the El Segundo blue butterfly (Air Force 2010).

Surveys were also conducted within habitat accessible to the public outside of VAFB. These sites included Sweeney and Santa Rosa Roads in Lompoc. The butterflies observed were morphologically consistent with the El Segundo blue butterfly and were found in association with flowering seacliff buckwheat stands. Subsequently, both Dr. Richard Arnold and Dr. Gordon Pratt determined these butterflies to be the El Segundo blue butterfly through examination of genitalia. A total of 18 El Segundo blue butterflies and approximately 26 acres of occupied habitat were documented in these areas (Air Force 2010).

ENVIRONMENTAL BASELINE

The implementing regulations for section 7(a)(2) of the Act define the “action area” as all areas to be affected directly or indirectly by the Federal action and not merely the immediate area involved in the action (50 Code of Federal Regulations (CFR) 402.02). For the purposes of this biological opinion and based on information provided by the Air Force, we consider the action area to include the SLC-4E complex; including the 300-foot launch overpressure zone that buffers the interior portion of SLC-4E.

The Air Force conducted surveys for the El Segundo blue butterfly in March 2010, outside of the period of time when El Segundo blue butterflies could be observed, and during the flight season with no positive observations. The potential for this species to be present is based on the presence of its host plant, seacliff buckwheat. The overpressure zone surrounding the SLC-4E facility is approximately 1.2 miles from the nearest known location of the El Segundo blue butterfly. The seacliff buckwheat plant occupies approximately 0.4 acre within the SLC-4E complex. An unknown quantity of seacliff buckwheat plants are widely scattered in low densities in the overpressure zone.

EFFECTS OF THE ACTION

The actions that would affect the El Segundo blue butterfly are actions that would affect its host plant, including mowing, landscape maintenance, and fire. All life stages of the El Segundo blue butterfly associated with their host plants could be affected. The vegetation within the complex may be mowed as often as biweekly, but the frequency depends on the time of year and the growth rate of vegetative material. These mowed areas have been previously disturbed and will continue to be maintained for as long as the facility is active. Seacliff buckwheat plants will be flagged and avoided, when possible, but only if the flagged plants do not interfere with program activities. Based on the continuous disturbance to the site, we assume that the mowed areas of SLC-4E would lack any habitat value for the El Segundo blue butterfly, and therefore, 0.4 acre of suitable but unknown to be occupied habitat would be affected. The launch activities have the potential to start a brushfire in the overpressure zone and destroy all of the seacliff buckwheat plants present; however, fire is not expected throughout the entire zone and is anticipated to be restricted to the launch plume.

The Air Force proposed to plant seacliff buckwheat plants, at a 1:5 ratio (plants affected to plants restored), to replace the buckwheat plants that they remove or destroy. The placement of seacliff buckwheat plants at an area designated by a biologist familiar with the habitat requirements of the El Segundo blue butterfly could improve and (or) add to the available habitat on base.

CUMULATIVE EFFECTS

Cumulative effects include the effects of future State, tribal, local, or private actions that are reasonably certain to occur in the action area considered in this biological opinion. Future Federal actions that are unrelated to the proposed action are not considered in this section because they require separate consultation pursuant to section 7 of the Act. We are not aware of any non-Federal actions that are reasonably certain to occur in the action area.

CONCLUSION

After reviewing the status of the El Segundo blue butterfly, the environmental baseline, the effects of the action, and the cumulative effects, it is the Service's biological opinion that the proposed modification and operation of SLC-4E on VAFB is not likely to jeopardize the continued existence of this species. We reached this conclusion because:

1. The host plants at the project site are only a small portion of the suitable and unknown to be occupied El Segundo blue butterfly habitat on VAFB, and an even smaller percentage of the available habitat range wide. The loss of this small amount of suitable habitat would not diminish the range-wide survival and recovery needs of the El Segundo blue butterfly.

2. The Air Force proposes to replace lost seacliff buckwheat plants at a 1:5 ratio, which would increase the available host plants for the El Segundo blue butterfly on VAFB.

INCIDENTAL TAKE STATEMENT

Section 9 of the Act and Federal regulation pursuant to section 4(d) of the Act prohibit the take of endangered and threatened species, respectively, without special exemption. Take is defined as to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture or collect, or to attempt to engage in any such conduct. Harm is further defined by the Service to include significant habitat modification or degradation that results in death or injury to listed species by significantly impairing essential behavioral patterns, including breeding, feeding, or sheltering. Harass is defined by the Service as intentional or negligent actions that create the likelihood of injury to listed species by annoying it to such an extent as to significantly disrupt normal behavioral patterns which include, but are not limited to, breeding, feeding, or sheltering. Incidental take is defined as take that is incidental to, and not the purpose of, the carrying out of an otherwise lawful activity. Under the terms of section 7(b)(4) and section 7(o)(2), taking that is incidental to and not intended as part of the agency action is not considered to be prohibited taking under the Act provided that such taking is in compliance with this incidental take statement.

The measures described below are non-discretionary and must be undertaken by the Air Force for the exemption in section 7(o)(2) to apply. The Air Force has a continuing duty to regulate the activity covered by this incidental take statement. If the Air Force fails to adhere to the terms and conditions of the incidental take statement through enforceable terms that are added to the permit, the protective coverage of section 7(o)(2) may lapse. To monitor the impact of incidental take, the Air Force must report the progress of the action and its impact on the species to the Service as specified in the incidental take statement [50 CFR 402.14(i)(3)].

We anticipate that El Segundo blue butterfly individuals would be subject to take because the landscape maintenance actions and fire that damage, destroy, or remove seacliff buckwheat plants could result in harm, injury, or mortality of individual butterflies. This species spends the vast majority of its life in close association with the seacliff buckwheat plant and removing the host plant could result in mortality or injury to any life stage of butterfly. Damaging individual seacliff buckwheat plants to the point where they would not provide the adequate life-supporting attributes for El Segundo blue butterflies could harm individual butterflies by significantly impairing essential behavioral patterns, including breeding, feeding, and sheltering.

We cannot predict the number of individual butterflies that would be taken as a result of the proposed actions. Because of their cryptic nature, fluctuations in abundance from one generation to the next and from one flowerhead to another, and potentially high parasitism and natural mortality rates (Arnold, pers. comm. 2007), detecting dead or injured El Segundo blue butterflies as a result of the proposed actions would be very difficult. Due to court rulings that have determined that a specific number must be provided at which consultation would be reinitiated, we are using the Reasonable and Prudent measures and Terms and Conditions of this Incidental Take Statement to define the reinitiation trigger for this project. The El Segundo blue butterfly may be taken only within the boundaries of the action area.

REASONABLE AND PRUDENT MEASURE

We believe the following reasonable and prudent measure is necessary and appropriate to minimize take of the El Segundo blue butterfly:

> The Air Force must ensure that the level of incidental take that occurs during project implementation is commensurate with the analysis contained in this biological opinion.

TERM AND CONDITION

To be exempt from the prohibitions of section 9 of the Act, the Air Force must comply with the following term and condition, which implements the reasonable and prudent measure described above. This term and condition is non-discretionary.

> If more than 0.4 acre of seacliff buckwheat plants are damaged or destroyed within SLC-4E due to program activities, any operations causing such take must cease pending reinitiation. Acreage is the trigger for reinitiation instead of individual butterflies because finding dead or injured butterflies would be very difficult, and determining damage to its habitat would be an easier trigger to identify.

REPORTING REQUIREMENT

The Air Force must provide a report to the Service within 90 days following the completion of the activities covered by this biological opinion. The report must document the number of El Segundo blue butterflies killed or injured during the course of the project; a summary of how the term and condition worked; and any suggestions of how the measure could be changed to improve conservation of these species while facilitating compliance with the Act. This document will assist the Service in evaluating appropriate measures for conservation of the El Segundo blue butterfly during future projects.

DISPOSITION OF DEAD OR INJURED SPECIMENS

Upon locating a dead or injured El Segundo blue butterfly, initial notification must be made by facsimile (805) 644-3958 immediately and in writing to the Ventura Fish and Wildlife Office in Ventura, California, (2493 Portola Road, Suite B, Ventura, California 93003, (805) 644-1766) within 3 working days of the finding. The report must include the date, time, and location of the carcass, a photograph, cause of death, if known, and any other pertinent information.

Care must be taken in handling injured specimens to ensure effective treatment and care and in handling dead specimens to preserve biological material in the best possible state for later analysis. The collector of injured specimens has the responsibility to ensure that evidence intrinsic to the specimen is not unnecessarily disturbed, unless to remove it from the path of further harm or destruction. Should any listed species survive injury, the Service must be contacted regarding their final disposition.

The remains must be placed with educational or research institutions holding the appropriate State and Federal permits, such as the Santa Barbara Natural History Museum (Contact: Paul Collins, Santa Barbara Natural History Museum, Vertebrate Zoology Department, 2559 Puesta Del Sol, Santa Barbara, California 93460, (805) 682-4711, extension 321). The Air Force must make arrangements with the Museum regarding proper disposition of potential museum specimens prior to implementation of any project actions.

CONSERVATION RECOMMENDATIONS

Section 7(a)(1) of the Act directs Federal agencies to use their authorities to further the purposes of the Act by carrying out conservation programs for the benefit of endangered and threatened species. Conservation recommendations are discretionary agency activities to minimize or avoid adverse effects of a proposed action on listed species or critical habitat, to help implement recovery plans, or to develop information.

> We recommend that the Air Force continue conducting El Segundo blue butterfly surveys of any areas at VAFB that contain seacliff buckwheat to refine our knowledge of the species distribution.

REINITIATION NOTICE

This concludes formal consultation on the effects of the modification and operation of SLC-4E for the Falcon 9 and Falcon 9 Heavy programs at VAFB. Reinitiation of formal consultation is required if: 1) the amount or extent of incidental take is exceeded; 2) new information reveals effects of the agency action that may adversely affect listed species or critical habitat in a manner or to an extent not considered in this biological opinion; 3) the agency action is subsequently modified in a manner that causes an effect to a listed species or critical habitat that was not considered in this biological opinion; or 4) a new species is listed or critical habitat designated that may be affected by this action (50 CFR 402.16). In instances where the amount or extent of incidental take is exceeded, the exemption issued pursuant to section 7(o)(2) will have lapsed and any further take would be a violation of section 4(d) or 9. Consequently, we recommend that any operations causing such take cease pending reinitiation.

If you have any questions regarding this biological opinion, please contact Nic Huber of my staff at (805) 644-1766, extension 249.

Sincerely,

/s/: Diane K. Noda

Diane K. Noda
Field Supervisor

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STATE OF CALIFORNIA – NATURAL RESOURCES AGENCY ARNOLD SCHWARZENEGGER, GOVERNOR

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November 16, 2010

Beatrice L. Kephart
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30 CES/CEA
1028 Iceland Avenue
Vandenberg AFB, CA 93437-6010

Subject: Negative Determination ND-055-10 (Modifications to Space Launch Complex 4 East to support Falcon 9 and Falcon 9 Heavy Launch Vehicle Programs, Vandenberg Air Force Base, Santa Barbara Co.)

Dear Ms. Kephart:

The Coastal Commission staff has reviewed the above-referenced negative determination. The Air Force proposes to modify Space Launch Complex 4 East (SLC-4E) to support the Falcon 9 and Falcon 9 Heavy launch vehicle programs at Vandenberg Air Force Base. In December 2003 the Executive Director concurred with the Air Force's ND-103-03 for implementation of the Falcon 1 launch vehicle program at Space Launch Complex 3 West, and in August 2005 concurred with ND-088-05 for relocation of that program to Space Launch Complex 4 West. The Executive Director determined that those programs would not generate new or additional adverse impacts on coastal resources not previously examined by the Commission in its concurrence with a consistency determination by the Air Force (CD-049-98) for launch activities at the adjacent SLC-3E. The Falcon 9 and Falcon 9 Heavy are significantly larger launch vehicles compared to the Falcon 1, and the facilities at SLC-4W are not able to accommodate the larger Falcon vehicles. SLC-4E supported launch operations for the larger and more powerful Titan IV launch vehicle through 2005 and as a result the Air Force proposes to modify SLC-4E to accommodate the Falcon 9 program operated by Space Exploration Technologies (SpaceX).

The Air Force decommissioned SLC-4E in 2005 at the end of the Titan IV program but continued to implement security and fire suppression requirements at the complex, including vegetation control (e.g., mowing and disking of fire breaks and fire access roads) within the interior of the complex as well as the immediate exterior. The proposed modifications and construction activities for the Falcon program would occur within the existing perimeter of the SLC-4E complex and up to 30 feet outside the exterior fence line (for continuation of ongoing vegetation management activities). Proposed modifications to SLC-4E include demolition of some existing facilities, improvements to the administrative building, re-installing and/or re-initiating utilities, installing propellant tanks, resurfacing the launch water deluge drainage and retention basin, resurfacing the entrance road, refurbishing the security system, and construction of a new Integration and Processing Hanger building. Construction is scheduled to start in 2011

and last approximately two years. The Air Force and SpaceX anticipate a maximum of ten launch operations per year, divided equally between the Falcon 9 and Falcon 9 Heavy vehicles, to place government and commercial payloads into earth orbit in polar and sun-synchronous inclinations.

Endangered Species Act Section 7 consultation with the U.S. Fish and Wildlife Service is currently underway to establish protective measures for federally listed species that may be affected by the proposed construction and launch program activities, in particular the El Segundo blue butterfly and the seacliff buckwheat host plant. The Air Force will ensure that SpaceX will fund, implement, and comply with all measures, terms and conditions included in the resulting Biological Opinion to compensate for any potential adverse impacts to listed species. To protect special status marine mammals that may be present underneath the launch path, the Falcon program is subject to the protective measures described in the Letter of Authorization to the Air Force issued by the National Marine Fisheries Service on January 25, 2010, for missile and rocket launches at Vandenberg AFB. The Air Force states that all launch programs at Vandenberg AFB are required to establish debris impact corridors as an element of a program's safety review in case of a launch anomaly that requires destructive fight termination. As a part of that review, Ocean Beach and Jalama Beach county parks fall within debris impact corridors requiring their closure during launch operations, as is presently done for all space launches at South Vandenberg AFB. In conclusion, because construction activities would be located within the existing perimeter of SLC-4E, as the Falcon 9 and Falcon 9 Heavy launch vehicles are smaller than the Titan IV vehicles that previously used SLC-4E, and because no significant impacts on coastal resources (beyond temporary beach access closures) were documented as a result of noise, sonic boom, and exhaust materials from the Titan launches at SLC-4E, no significant impacts to coastal resources are expected to occur from modifications to SLC-4E or from the Falcon vehicle launch program.

The Commission staff **agrees** that the proposed modifications to SLC-4E will not generate new or additional adverse impacts on coastal resources not previously examined by the Commission in CD-049-98 and ND-088-08 for launch activities on South Vandenberg AFB. Under the federal consistency regulations, a negative determination can be submitted for an activity "which is the same as or similar to activities for which consistency determinations have been prepared in the past." We therefore **concur** with your negative determination made pursuant to 15 CFR 930.35 of the NOAA implementing regulations. Please contact Larry Simon at (415) 904-5288 should you have any questions regarding this matter.

Sincerely,

(for) PETER M. DOUGLAS
Executive Director

cc: Andrew Edwards, VAFB
CCC – South Central Coast District
California Department of Water Resources
Governor's Washington, D.C., Office

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November 16, 2010

Reply in Reference To: USAF100915A

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1172 Iceland Avenue
Vandenberg AFB, CA 93437-6012

Re: Section 106 Consultation for Proposed Reuse of Space Launch Complex 4 East, Vandenberg AFB, Santa Barbara County

Dear Mr. Cote:

Thank you for initiating consultation regarding the United States Air Force's (USAF) efforts to comply with Section 106 of the National Historic Preservation Act of 1966 (16 U.S.C. 470f), as amended, and its implementing regulation found at 36 CFR Part 800.

The commercial space launch company SpaceX is entering into a long term lease agreement with the USAF for the use of the Space Launch Complex 4 (SLC-4E) at Vandenberg AFB. The subject site has been used extensively in the past for rocket launching and contains a number of existing structures and facilities. To prepare this site for reuse, the USAF is proposing the following project components:

- Resurfacing of SLC-4E access road;
- Demolition of Facilities 713, 714, 715, 716, 719, 722, 726;
- Modifications and/or improvements to main administration building, security system and drainage features;
- Ground disturbance will be to a maximum of two feet below grade
- Construction of an approximately 25,000 square foot pre-fabricated steel or aluminum hangar and adjacent 7500 square foot paved parking area;
- Installation generators, fuel tanks, and utilities.

The project area has been extensively disturbed by testing since its construction in the late 1950s however, the results of an archeological records search and pedestrian survey identified two National Register (NRHP) eligible sites in SLC-4E. These prehistoric sites, CA-SBA-537 and -1816 are not located near any planned project activities and will not be affected by any proposed work. Additionally, according to the documentation submitted by the USAF, all features and structures in the SLC-4E have been determined not eligible for NRHP listing through consultation with my office. As a result, the USAF is requesting my concurrence with the determination of no adverse effect.

The USAF has submitted maps delineating the project area and area of potential effect (APE), evidence of tribal consultation and the following document in support of this undertaking:

- *Archeological Survey for the Falcon Launch Programs at SLC-4E, Vandenberg Air Force Base Santa Barbara, California* (Lepow: May 2010)

After reviewing this information, I have the following comments:

1) I concur that the Area of Potential Effects (APE) has been properly determined and documented pursuant to 36 CFR Parts 800.4 (a)(1) and 800.16(d).

2) I concur that a finding of No Adverse Effect is appropriate pursuant to 36 CFR Part 800.5(b) for this project and that the documentation supporting this finding has been provided pursuant to 36 CFR Part 800.11(d).

3) Please be advised that under certain circumstances, such as an unanticipated discovery or a change in project description, you may have future responsibilities for this undertaking under 36 CFR Part 800.

Thank you for seeking my comments and considering historic properties as part of your project planning. If you have any questions or concerns, please contact Ed Carroll of my staff at (916) 445-7006 or email at ecarroll@parks.ca.gov.

Sincerely,

Susan K Stratton for

Milford Wayne Donaldson, FAIA
State Historic Preservation Officer